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THE PROSPECTS OF ELECTRIC LIGHTING.

ARE the prospects of electric lighting at the present moment as full of promise as appeared to be the case at the close of last year, or indeed, has any real advance been made since that time? It will, we think, be admitted by all reflecting men that, although the period we are now passing through has been more gloomy and depressing than the most far-sighted could have foretold, it yet gives us more hope for the future than did all the sensational circumstances connected with the same period of twelve months ago. We can now count, on the fingers of one hand we might almost say, the solvent electric light companies left to us of the great number floated. We cannot call to mind any new or startling invention likely to give a fresh impetus to electric lighting, or to regain the lost confidence of the public. Yet we believe that more real work is now being quietly accomplished than the public is aware of. At present the fitting of the electric light on board ship appears to constitute the chief amount of business done by electric light companies, and that this is proceeding rapidly is clearly shown by a glance at our "Notes" columns from week to week. Now that ship lighting by electricity is progressing so fairly, there seems to be but little room for doubt but that eventually the electric light will be essential for all steam ships of any repute. Those electrical companies which, by prudence and foresight, have made preparations for the supply of this particular branch of electric lighting, will, in all probability, reap a considerable reward. A certain amount of activity in lighting up hotels, warehouses, and retail shops, by the incandescence lamp, is apparent, and this will assuredly develop itself in the immediate future amongst those who can afford to pay for their own generating machinery.

As far as house to house lighting is concerned, we do not appear to have advanced in the least. We can still only point to the admirable installation of the Edison Company on the Holborn Viaduct, which, however, has not been augmented by any additional circuits. Several attempts have recently been made by the promoters of primary batteries to lead people to believe that by means of these, economical house lighting by electricity can be attained. We do not hear of any material successes gained in this direction, and, indeed, when our greatest chemists and electricians have for ever given up the idea that electrical energy can be economically obtained from primary batteries in which zinc is employed, it is hardly to be expected that men who, in some cases, are neither electricians nor chemists can hope to succeed. Primary batteries may, we hope they will, be largely used for electric lighting purposes, but they should not be brought forward as a *cheap* means of producing electrical energy. Secondary batteries or accumulators have turned out decidedly disappointing, and at present they appear to be taking a retrograde movement. Great improvements have certainly been *spoken* of, but that is all. It is not to be expected that we shall be able to make any important modifications in dynamo-electric machines in the way of cheapening the supply of electricity, but there is room for the belief that a considerable increase in the economy of incandescence lamps may be effected. For instance, if the Cruto lamp should prove itself as good as reported in our last week's issue, we have at once the means of greatly cheapening electric lighting by incandescence.

In spite of the apparent stand-still of the last few months, we believe that electric lighting will henceforth gradually assert its importance. It is hardly likely that companies will again be floated whose prospectuses will not bear the strictest scrutiny from both commercial and technical points of view. The days of wild speculation have passed away, and the public should by this time be aware of what can, and what cannot, be accomplished with respect to electric lighting.

Electric light contractors will go to work more methodically, we shall hear less of failures and more of the successes, and electric lighting will eventually assume a position which, although it may never equal that of gas, will at least be one of considerable importance amongst the industries of our country.

SPECIAL USES OF THE ELECTRIC LIGHT ON SHIPS.

THE U.S. Fish Commission steamer *Albatross*, whose duties often keep her at sea for many days at a time, has been illuminated throughout by the best system of artificial lighting to be found in the United States. In other words, the Commissioner of Fish and Fisheries has selected the Edison system of electric lighting for the objects required. The plant on board the *Albatross*, says Mr. G. W. Baird, in the American journal *Science*, consists of an eight-and-a-half by ten Armington and Sims engine, an Edison Z dynamo having its field-magnets vertical, a resistance-box in the circuit of the magnetic field, the main and branch wires, lamp fixtures, safety-catches, and lamps.

Where the wires passed damp places, continues our informant, they were incased in rubber tubes, besides their insulation of cotton-cloth and white lead; in all hot places they were encased in lead pipe; where they passed through iron bulk-heads or beams, ferrules of hard rubber or gutta-percha were used; and the mains, instead of being single wires of large size, were composed of a number of smaller wires, which, of course, made them more flexible. Where the wires passed an iron surface, such as a lodger-plate or stringer, they were fitted to a groove in a wooden batten; and where they passed a wooden surface, they were embedded into a groove in the wood; and, when carefully painted over, it was difficult to detect their presence. The main wires, as far as possible, were led behind the wooden lining of the ship. Where the wires were spliced or "tapped," their insulation was removed, and the naked metallic surfaces brightened with sandpaper, to ensure metallic contact. They were then twisted together tightly and soldered. The naked place was then covered with insulation-tape, which is common

cotton tape saturated with a bituminous insulation compound manufactured by the Edison Company, the components of which are kept a profound secret.

The average life of a lamp is said to be about 1,000 hours, when kept up to its normal incandescence; but they will last much longer if their brightness is a little suppressed. On board ship, however, about as many lamps are broken by accident as from natural deterioration. The cost of the lamps is one dollar each; and, at the present rate of consumption from all causes, the annual expenditure will be 56 lamps. The dynamo is run about 2,190 hours per year (about six hours per day, with an average of about 47½ lamps in circuit, so that the annual lamp-hours would be about 104,025 (2,190 × 47·5). Thus it appears that our lamps will, at present consumption, last us in the neighbourhood of 1,857 ($\frac{104025}{56}$) hours each.

Description of lamps.

Designation of lamps.	Candle-power.	Resistance in ohms.	Current in ampères.	Electromotive force in volts.
A	32	86	1·180	102
A	16	137	0·745	102
A	10	250	0·400	102
B	8	69	0·745	51
B	16	42	1·200	51

To determine the efficiency of the system of incandescent lamps, I measured, says the writer, by means of a steam-engine indicator, the power required to run the engine and dynamo, the current being switched off. By the same instrument I measured the indicated power required to run 45, 50, and 70 lamps respectively. By deducting from these experiments, respectively, the power required to run the engine and dynamo, we obtained the power applied to the shaft; and from this quantity we deducted the friction of the load, leaving, as a remainder, the net powers required to revolve the armature in the magnetic field with 45, 50, and 70 lamps in circuit. The lamps used were each of 8 candle-power.

Efficiency of the incandescent lamps.

Horse-power required to run the engine and dynamo ...	5·36
Indicated horse-power required to run 45 incandescent lamps	5·79
Indicated horse-power required to run 50 incandescent lamps	5·85
Indicated horse-power required to run 70 incandescent lamps	6·92
Net horse-power applied to the revolution of the armature in the magnetic field, using 45 incandescent lamps ...	1·80
Net horse-power applied to the revolution of the armature in the magnetic field, using 50 incandescent lamps ...	1·85
Net horse-power applied to the revolution of the armature in the magnetic field, using 70 incandescent lamps ...	2·84
Mean number of incandescent lamps per indicated H.P., using 45 lamps	7·77
Mean number of incandescent lamps per indicated H.P., using 50 lamps	8·50
Mean number of incandescent lamps per indicated H.P., using 70 lamps	10·11
Mean number of incandescent lamps per net H.P., using 45 lamps	25·
Mean number of incandescent lamps per net H.P., using 50 lamps	27·02
Mean number of incandescent lamps per net H.P., using 70 lamps	24·63

The wires being fixed, their resistance may be considered a constant quantity, and the only variation as existing in the engine and dynamo. The distribution of the power, as above recorded, may, if necessary, be verified by electrical measurements on the wires.

To illuminate the machinery on deck, the derrick-gaff, the lead of the cable, the trawl as it comes on deck, and to afford ample light to the naturalists while culling the contents of the trawl as delivered on deck, an arc light of great power became indispensable. In the then existing state of electric lighting, an additional dynamo appeared to be imperative, as no arc light had been run from a tension of 51 volts.

The Edison Company, however, was willing to experiment, and in a short time produced a lamp of 750 candle-power, which is now being used; and we find, in practise, that a No. 18 copper wire will carry the current without heating. The power of this lamp, to be comparable with other arc lamps, should be multiplied by four, as the commercial candle-power of the arc lamp is the aggregate of four measurements, the photometers being placed equidistant from each other in the same circumference. The power required to drive these arc lamps, though more than necessary for others of equal power, is yet quite small.

Efficiency of the arc lamps.

Indicated horse-power developed by the engine with two arc lamps in circuit	6·69
Horse-power required to drive the engine and dynamo ...	3·56
Net horse-power applied to the shaft	3·13
Horse-power absorbed in the friction of the load	0·23
Net horse-power applied to the revolution of the armature in the magnetic field	2·90
Net horse-power applied to the armature for one lamp (half of the last quantity)...	1·45

The number of eight candle-power incandescent lamps per indicated horse-power is taken as a mean between the quantities as determined above, *i.e.* :—

$$\left(\frac{25 + 27{\cdot}02 + 24{\cdot}63}{3} = \right) 25{\cdot}55;$$

and this quantity multiplied into the net horse-power required to drive one arc lamp gives (25·55 × 1·45 =) 37·04, which is the power in units, of incandescent lamps, to run one arc lamp of 750 candle-power.

Fishermen in nearly all parts of the world use a light in their boats, when fishing at night, to attract fishes into their nets; and it is a common thing for flying fish to come on board ship at night if a light be advantageously placed to attract them.

Until incandescent lamps were invented, there were no convenient means of sustaining a light beneath the surface of the waters; and there is consequently opened up to us an unexplored field in fishing.

Just what service our submarine lamps will be, we are as yet unable to say; but with the small lamp which we use from one to ten feet below the surface, amphipods in great numbers, silver-sides, young blue-fish, young lobster, squid, and flying-fish have been induced into the nets, and dolphins have approached it; but whether the dolphins were attracted by the light, or were pursuing the squid, Professor Benedict, the naturalist of the ship, was unable to say. Squid are especially susceptible to the influence of light. I am informed by the very eminent authority of Professor Verrill, of Yale College, that a heavy sea, breaking upon a lee shore when the full moon is casting its rays across the land into the sea, will throw hundreds of squid upon the beach in a single night—an evidence of their moving in the direction of the light until caught in the spray and hurled upon the shore.

To succeed in producing the light at considerable depths has been by no means easy.

The Edison Company first prepared a lantern of two thicknesses of glass, hemispherical in form, with its flat side tightly joined to a bronze disc on which were placed three 16 candle-power B lamps in multiple arc. At a moderate depth it burned beautifully; but at about a hundred and fifty feet the packing leaked, and the sea-water entering, short-circuited, and the lamp was extinguished by the destruction of the cut-out plug. A similar lamp was then tried with improved packing; but its glass walls were crushed by the pressure of the water, and it was extinguished.

The next essay was with a single Edison lamp. its glass vessel being cylindrical in form, with hemispherical end, to give it strength; its thin platinum wires extending through one end without any external attachment. To these delicate wires I succeeded in soldering the copper wires of the cable, but broke (or cut) off one of the platinum wires at the point where it enters the glass, while putting on the insulation. When it is remembered that a hundred fathoms depth of water brings a pressure of over 250 lbs. per square inch on the lamp, it will be understood that great care was required in every procedure.

Our next attempt was with a single Edison lamp exactly the same as the last. I succeeded in soldering and insulating the joints perfectly; but the pressure of the water upon the insulation cut the delicate platinum wire on the glass before it had reached a hundred feet in depth.

The Edison Company then produced a lamp in which the platinum wires were soldered to copper wires in a glass cavity, and filled in with rosin, so that copper wires, about No. 30 in size, projected from the lamp for our attachment. I coiled the copper wires spirally, and soldered their ends to the ends of the heavy wires of the cable, separating them by a small block of pine wood: this gave some freedom of motion, without danger of cutting or breaking the wires. A paper mould was placed round the joint, and filled with warm insulating compound. When this had cooled, it was wrapped with insulation tape, and served tightly with twine. This was again covered with the compound, then tape, and finally with melted gutta-percha, and when the gutta-percha had cooled, its entire surface was seared over with a hot iron to make sure of filling any cracks or holes it might contain. The lamp was then lowered into the sea, about 750 feet of cable being paid out, without any indication of failure. To ascertain if the lamp was lighted at all times, we substituted a lamp for the cut-out plug in the deep-sea circuit. This brought both lamps in the same circuit, which caused them to glow at about a cherry-red instead of a white light; and had any accident happened to break the lamp in the water, or to cause a leak, our upper lamp would have immediately sprung into incandescent whiteness.

REVIEW.

*The Magneto and Dynamo-Electric Machines, their Construction and Practical Application in Electric Lighting and in the Transfer of Power.** By Dr. H. SCHELLEN. Third edition, revised and extended with the co-operation of Dr. Victor Wietlisbach.

We have here an extensive and most profusely illustrated manual of the theory and practice of magneto and dynamo-electric machines, in accordance with the knowledge and experience of the present day.

The authors commence with a discussion of the general physical principles involved. They describe the electro-magnet, the action of a magnet upon soft iron, the magnetic field and the lines of force. They then treat of Ampère's solenoid and of steel magnets regarded as systems of galvanic currents; of the reciprocal action of galvanic currents, &c.

In all this there is, of course, little scope for originality, but we recognise a most satisfactory clearness of description.

In the second chapter we find an account of the methods of electric measurement, and of the requisite instruments such as the dynamometers of Ayrton and Perry, and of Von Hefner-Alteneck, the electro-dynamometer of Siemens-Halske, the galvanometers (otherwise called Ampère-meters or Volt-meters) of Deprez and of Ayrton and Perry, the torsion-galvanometer of Siemens-Halske, Edison's registering apparatus, &c. In this chapter are also included a statement of Ohm's law and an account of the electric units of measurement as determined by the Congress of Electricians held at Paris in 1881, and in comparison with the units formerly accepted in Germany.

With natural reference to electric lighting the question of photometry is here introduced. The methods involving the use of a standard lamp or candle, of whatever materials constructed are very justly condemned as incapable of giving constant and comparable results.

The photometer of Bunsen, and the modification devised by Edison are described with the remark that, the latter instrument is only in exceptional cases available for the measurement of arc lights, on account of the great space required. The dispersion photometer of Ayrton and Perry is also described and figured, but the author gives no opinion as to its merits.

In successive chapters we next find an account of magneto-electric machines of different makers, of dynamo-electric machines, and of machines for the production of continuous currents formed in two halves joined up in parallel arc. Under this head come, of course, the machines of Pacinotti and of Gramme in various modifications. The defects of the Gramme machines are summed up as due to the relatively incomplete utilisation of the copper wire forming the ring and in the heating of the ring itself and of the electro-magnets. The author speaks, however, hopefully as to the ultimate success of the attempts made by Gramme himself and by others for the removal of these imperfections.

The more recent machines for the production of alternating currents, such as that of Lontin, are next considered, but with the remark that physicists and engineers are more and more coming to the conclusion that such machines, under equal circumstances can never compete to advantage with continuous current machines.

The theory of the dynamo-electric machine, of course from a mathematical point of view, is next taken into consideration.

The electric arc and its luminosity form the subject of an extensive chapter. Dr. Schellen is of opinion that much remains to be done in the preparation of carbon-rods, so as to remove all present imperfections. The efforts in this direction made by Carré, Gaudoin, and by Siemens & Co., are favourably mentioned.

The carbons of Carré are still somewhat defective as regards permanence, and they occasion at times slight irregularities in the strength of the light.

Gaudoin in coming to the conclusion that the presence of foreign matter in carbon might increase the strength of the light, but was otherwise injurious by the production of flames and smoke, and finally devised the method of submitting oils, resins, &c., to ignition in closed crucibles of graphite. The carbon thus obtained is ground to fine powder, mixed with hydro-carbons and moulded into suitable rods under strong pressure. The light obtained by means of Gaudoin's rods exceeded that producible with those of Carré in the proportion of 205 to 150. The carbons of Archereau give so fluctuating a light that its strength could only be measured with difficulty. More recently the carbons of Napoli have met with great approval.

The author next discusses the methods proposed for the division of the arc light, the electric "candles" of Jablochkoff and Jamin, the incandescence or glow systems of Lontin, Edison, Swan, Maxim, and others, and the driving and regulating apparatus. The author contends that it is an error to suppose that incandescence supplies means for the unlimited subdivision of the electric light. He reminds the reader, also, that the light is by no means proportional to the heat evolved in the lamp.

In the fourteenth chapter we find a consideration of certain important points connected with electric lighting. The first question is that of single or divided lights. It is easily demonstrable that the sum of the lights obtained from a number of divided lamps cannot possibly equal that obtained with the same electric action from a single lamp; but it must, of course, depend upon the conditions of each case whether a single intense light, or an equably diffused, though less powerful illumination, is preferable. All artificial lights, like the moon, have the defect of throwing dark shadows where their direct rays do not fall. The sun alone emits such a quantity of light that even the shadow side of opaque objects is fairly illuminated by diffusion and reflection. No one lamp, it appears, can illuminate with tolerable equality a circular surface whose radius is greater than 1·414 times its height. If the space to be lighted up exceeds these dimensions, a division of the light is necessary. But with division is involved

* *Die Magnet, und Dynamo, Elektrischen Maschinen, ihre Construction und Praktische Anmendung zur Elektrischen Beleuchtung und Kraft übertragung.*

the evil that a more intense current is needed, and that the light becomes less like that of the sun. A single arc light, it is stated, will serve for 250 square metres of room in a printing office or a weaving shed, in a machine factory for 580 square metres, and in uncovered work places for 2,000. Much, of course, depends on the position of the lamp. As a successful instance, mention is made of the Anhalt Railway Station, at Berlin, a covered hall of about 4 acres surface. This is so well illuminated by means of 24 differential lamps, of 350 normal candle-power each, that the smallest print can be read, even at the darkest part of the platforms.

The advantages of the electric light are very fairly discussed. As regards the colour of the light, prominent mention is made of a fact often overlooked, *i.e.*, that whilst the light given off by the carbon points themselves is in its relative composition substantially identical with sun-light, the light of the arc itself, *between the carbons*, is poor in the red rays, rich in the blue, and has a larger proportion of the violet rays than sun-light. The farther the carbons are withdrawn from each other, the more does this violet predominate in the total light produced. The light of gas, candles, and oil lamps, on the other hand, is rich in the red, orange and yellow radiations, but poor in the green, poorer still in the blue, whilst the violet is almost wanting. In all manufactories where it is necessary to judge accurately of colour, such as dye works, colour works, sugar works, nitre and white-lead works, &c., the arc light, so arranged that the bulk of the illumination is obtained from the carbon points, is consequently preferable to any other known. As further advantages of the electric light, are enumerated the purity of the air in rooms and halls so illuminated, and the absence of the oppressive heat experienced where many gas jets are in use.

Mention is made of the experiments of the late Sir W. Siemens, from which it would appear that the electric light exercises a favourable influence upon the maturing of flowers and fruits. It is right, however, to mention that some of these results have not been confirmed by subsequent experiments. Thus, it is maintained that fruits ripened by the electric light are deficient in flavour.

As regards economy, Dr. Schellen, after a cautious comparison of different authorities, decides in favour of the electric light as compared with gas. Nor does he omit to point out its comparative freedom from danger, and its admissibility into libraries, picture galleries, &c., where gas has necessarily been excluded.

In the fifteenth chapter the author takes into consideration a variety of useful purposes to which the magneto and the dynamo-electric machines may be applied. Some of these are too well known to require mention. The industrial production of ozone for technical purposes is, however, comparatively novel, and may become of importance. The same may be said concerning Goppelsröder's electric processes for tissue printing.

The last chapter of the work is devoted to the electric transfer of power. The experiments of Marcel Deprez at Munich, on the Northern Railway of France, and subsequently at Grenoble, are very fully described. As is well known, the *alleged* results are most satisfactory, but there still remains a certain element of doubt. The author regrets that no electric measurements were executed at Grenoble, a circumstance not quite free from suspicion.

Dr. Schellen is not an enthusiast for accumulators. Whilst considering that in certain cases they are necessary, he holds that as far as possible their use is to be avoided.

This work, as a whole, may be pronounced a most valuable manual, and may be recommended not merely to engineers, telegraphists, and other experts, but to those of the outside public who wish to know what electricity can really effect. It is not too much to say that, if carefully studied, it would sweep away the ignorance in which so many absurdities find a suitable soil.

A NEW DYNAMO-ELECTRIC MACHINE.*

CONTINUOUS current machines, whatever the form of the field magnets, armature, &c., present serious difficulties in construction, when it is required to make them of small size, which considerably augments their price. With the object of overcoming this difficulty, and of constructing at a moderate cost dynamo-electric

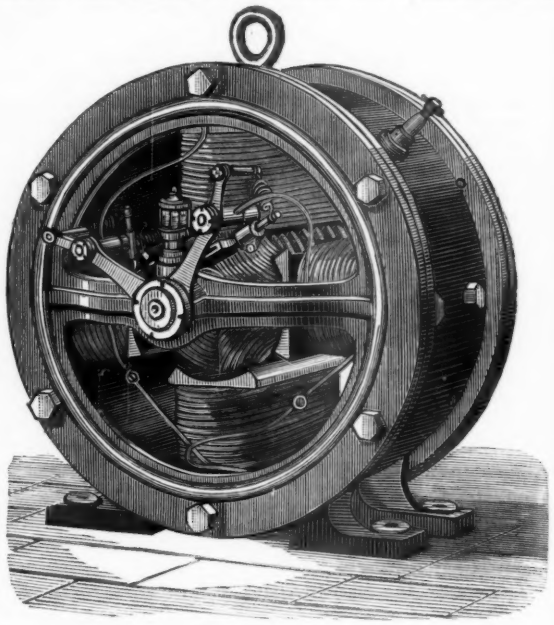


FIG. 1.

machines capable of employment for experimental and scientific purposes, M. Anatole Gérard has devised the dynamo-electric machine represented below. Fig. 1 is

FIG. 3.

a large model intended for industrial use, and actuated by a steam engine; it is the same in principle as the class-room model, worked by a handle (fig. 2), or the

* *L'Electricien.*

laboratory model, represented by fig. 3, and which is of great power.

This machine belongs to the class of commutated current dynamos with field magnets having movable poles, and with fixed inductors mounted in circuit. It is a series-dynamo. The inductor consists of a cast iron cylinder, upon the inside of which are disposed four electro-magnets in the form of a cross; these leave in the centre a cylindrical space in which the field magnet revolves. This field magnet is also formed of four radiating legs at an angle of 90 degrees. The four electro-magnets of the inductor are connected in series, and arranged so that when a current passes through them, the four poles developed opposite the field magnet are alternately of contrary sign and, consequently, diametrically of the same polarity.

The four bobbins of the legs of the field magnet are also connected in series, and the two free ends of the wire are connected with the plates of a commutator of a peculiar and novel form. In fact, if we examine the development of the induced currents in each of the four movable bobbins during a complete revolution of the machine, we see that this current changes its direction four times per revolution: the four bobbins are connected in series in such a manner that the electro-motive force developed increases every moment. But in order to send a current always in the same direction into the inductors and the external circuit, it must be necessarily commutated four times per revolution. This is accomplished by the commutator, formed of a cylindrical tube split in accordance with the four field magnet legs, fixed at 90 degrees in relation to each other; the four segments, which are insulated diametrically, are connected together two by two, the two ends of the wire of the field magnet being connected with each pair of segments. Two brushes, adjusted to 90 degrees, are applied to the commutator thus constructed; one of them is, consequently, in communication with one end of the wire of the field magnet, and the second with the other. A change of connections is therefore produced each time that the field magnet has completed a quarter of a revolution; the change of direction of the current in the field magnet taking place also at each quarter of a revolution, it follows that, by a suitable adjustment of the brushes, we can make the changes of connection coincident with the changes of sign, so that the external circuit, as well as the inductor electro-magnet will be traversed by a current always in the same direction, but becoming zero four times per revolution. This method of commutation of the current allows of making the commutator of simple form, and producing a machine at a low price. Although the current varies in intensity, since it is *nil* four times per revolution, the inductors maintain sufficient magnetism to prevent the machine losing power. The field magnets are formed of very thin sheets of iron plate placed close together, so as to reduce to a minimum the production of Foucault currents, and to facilitate rapid changes of polarity during rotation.

The class-room model is accompanied by a series of accessories for demonstrating simply and rapidly all the fundamental phenomena of electricity: compass, electro-magnet, electro-motor, incandescence lamp, fuses, voltameter, accumulator, baths for gilding, silvering, and nickel plating, electric bells, induction coil, Geissler tube, solenoid, galvanometer, &c., &c.

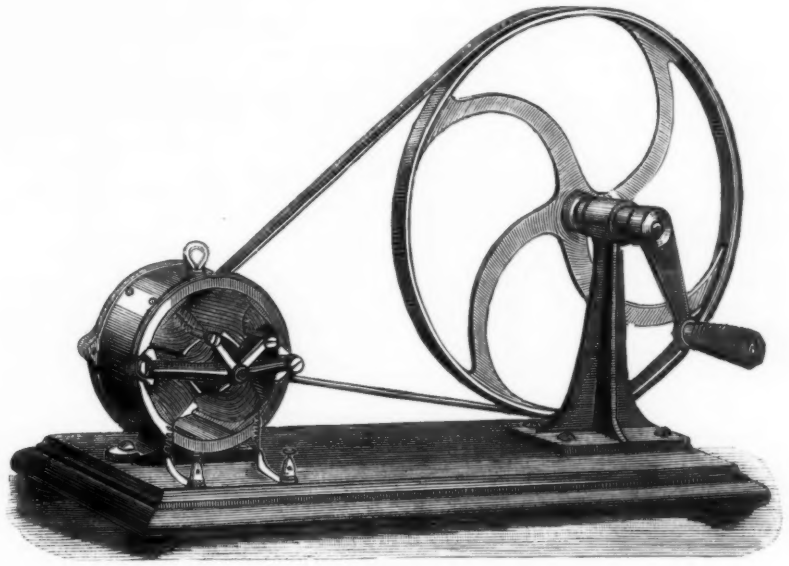


FIG. 2.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

(*Continued from page* 488.)

If we consider the conductors $+ d\ a$ and $- d\ a$ in fig. 2 to be the wires laid along a side street, then the branches, L_1, L_2, &c., will not be single lamps, but may each be considered to represent the whole group of lamps in one house; while, if we consider the conductors to be the mains in a principal street, the branches, L_1, L_2, &c., may be considered as representing the sub-mains branching into the side streets. L_1, L_2, &c., are not necessarily equal to one another. In order to determine the relative horse-powers used and wasted in a system of town supply, it is preferred to use the following method:—First mark out on a large-scale map of the district the number of lamps likely to be required in each block or house. Then draw the street-mains and branches radiating from the engine-house to the houses to be lighted. Then, starting from the furthest points on each branch, work up towards the engine-house, marking on each branch and main the number of lamps it has to carry. In a district so marked out plain numbers may be used to represent the number of lamps in the block or house on which they are marked, and numbers surrounded by a circle for the number of lamps whose current carried by the wire near which they are written. To avoid confusion, the + conductor only is shown, and when the H.P. wasted in it has been obtained, the result must be doubled to obtain the total waste in the + and − conductors. Knowing the current used per lamp, we know the number of ampères which each wire has to carry. It is noted that the "carrying" number in each branch is the sum of all the numbers beyond it, *i.e.*, on the side

furthest from the dynamo in that branch. *In order to secure the greatest economy of copper and of coals, the section of the conductor must be directly proportional to the current it has to carry*, i.e., *as we leave the dynamo, the section of conductor must diminish after each branch leaves it, in order that the same number of ampères per square inch may be carried by every part of the conductors throughout the system.* This condition being given, then, for a given district mapped out, the amount of H.P. wasted in the conductors is simply proportional to the number of ampères per square inch which we use. By the method to be explained, it is easy to calculate the amount of horse-power wasted in the whole district for any given number of ampères per square inch. In order to find the ampères per square inch corresponding to the particular percentage of horse-power that it is prepared to waste, we must assume some number of ampères arbitrarily, and find the actual horse-power wasted, and then the required number of ampères will bear the same ratio to the required horse-power that the arbitrarily-assumed number does to the horse-power corresponding to it. ... (4)

For example, suppose in a system where, say, 100 H.P. is being used in lamps, we are prepared to waste $12\frac{1}{2}$ H.P., and that with an assumed current of 500 ampères per square inch we find, by the method of calculation which we are about to give, that we waste 16 H.P., then the right number of ampères per square inch for us to use is

$$\frac{12\frac{1}{2}}{16} \times 500 = 390 \text{ ampères per square inch;}$$

and, if we have calculated the section of copper on the basis of 500 ampères per square inch, we must increase that section in the ratio of 16 to $12\frac{1}{2}$. When there are the same number of ampères per square inch in a system, the *horse-power wasted in each cubic inch of copper is the same throughout the whole system or district.* The resistance between the two faces of an inch cube of copper is ·0000007 (seven ten-millionths) of an ohm. The horse-power (H.P.) expended in a cubic inch of copper with a current of $\bar{c}$ ampères per square inch, is

$$\overline{\text{H.P.}} = \frac{\bar{c}^2 \times \cdot 0000007}{746} \quad \ldots \quad \ldots \quad (5)$$

With 500 ampères per square inch, the horse-power per cubic inch is

$$\overline{\text{H.P.}} = \frac{500^2 \times \cdot 0000007}{746} = \cdot 000234 \ldots \quad (6)$$

When the constant $\overline{\text{H.P.}}$ is known, and also the total number of cubic inches of copper in the district, we know the total horse-power wasted in the district. To determine the number of cubic inches of copper in the district, reference is made to the map, on which the number of lamps in each branch is marked, and we calculate a constant for the area of copper per lamp corresponding to our assumed current of, say, 500 ampères per square inch. For instance, if each lamp takes ·85 ampère, then for each lamp we must have

$$\frac{\cdot 85}{500} = \cdot 0017 \text{ square inch of copper.}$$

We then multiply the number of lamps on each section of the branch or main by this new constant, and we get the required area of this section, which we can mark on it on the map. We next multiply the area of each section by its length in inches, and this gives us its volume in cubic inches. Adding all the results thus obtained together, we get the total number of cubic inches of copper in the positive leads throughout the district. Twice this result is the total amount in the + and − leads together. Multiplying this result by H.P., the horse-power constant (which, when $\bar{c} = 500$, is equal to ·000234), we get the total horse-power wasted in the copper in the whole system. If the H.P. wasted is more or less than the desired amount, then $\bar{c}$ is altered proportionately to the desired change in the H.P. wasted.

We of course knew the H.P. expanded in the lamps, as we know the number of lamps and the H.P. expanded in each. If H.P._L is the total of H.P. used in the lamps, and H.P._W the total H.P. wasted, then the percentage P._W of the whole H.P. expended which is wasted in the leads is

$$\text{P.}_W = \frac{100\ \text{H.P.}_W}{\text{H.P.}_L + \text{H.P.}_W} \quad \ldots \quad \ldots \quad (7)$$

It has hitherto been assumed that all the lamps are alight whenever the current is flowing. In practice this will not be the case, and we must note that if, the conductors remaining unchanged, we diminish the number of lamps on every branch in a certain *uniform* ratio, we shall diminish the wasted H.P. *in the square of that ratio.* That is, if when 1,000 lamps are burning we are using 100 H.P. and wasting 10 H.P., then, if we reduce the number of lamps to 500, we shall reduce the used H.P. in the ratio of $\frac{500}{1000}$, *i.e.*, to 50 H.P., but we shall reduce the wasted H.P. in the ratio of $(\frac{500}{1000})^2$, or to $\frac{1}{4}$ of its former amount, namely, to $2\frac{1}{2}$ H.P. If H.P._{WM} is the H.P. wasted when M lamps are burning, and

H.P._{WN} " " N " "

then

$$\text{H.P.}_{WN} = \left(\frac{N}{M}\right)^2 \text{H.P.}_{WM} \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

The formula is only correct when the number of lamps diminishes uniformly over the whole system, *i.e.*, when an equal proportion of the lamps in every block are turned out simultaneously. In districts containing the same class of houses, the condition is sufficiently nearly approximated to in practice to make the formula (8) a useful one in calculating probable waste. Assuming then, this condition, we can if we know the general average habits of the district as to the use of light, calculate the total relative quantities of coals which will be used in the engines in producing useful and wasted electricity respectively. The coals used in an engine are practically proportional to the H.P.H. (horse power hours), *i.e.*, to the H.P. developed, multiplied by the hours during which the engine works. In order to determine the ratio of the coals used in producing wasted and useful electricity, we must take the H.P.H. used and wasted hour by hour throughout the night. Suppose that we have 1,000 lamps and a given system of mains, such that, when all the lamps are on, we use 100 H.P. and waste 10 H.P., and suppose that the number of lamps in use at the different parts of the night are as in the first two columns of the following table, then the H.P.H.'s used and wasted will be as in the fifth and sixth columns respectively, where the letters L and W stand for "used in lamps" and "wasted" respectively.

Hours.	Lamps burning.	H.P.L	H.P.W	H.P.H.L	H.P.H.W
Before 5 p.m.	Very few	Inappreciable	Inappreciable		
5—6 „	100	10	·1	10	·1
6—7 „	500	50	2·5	50	2·5
7—10 „	1,000	100	10·0	300	30·0
10—11 „	800	80	6·4	80	6·4
11—12 „	400	40	1·6	40	1·6
12—2 a.m.	200	20	·4	40	·8
After 2 „	Very few	Inappreciable	Inappreciable		
			Total	520	41·4

Thus, although the percentage H.P. wasted when all the lamps are on is from (7).

$$\text{P}_W = 100\frac{10}{100 + 10} = 9{\cdot}9 \text{ per cent.,}$$

yet the percentage of coals wasted in the whole night is only

$$\text{P.}_W = 100\frac{41{\cdot}4}{520 + 41{\cdot}4} = 7{\cdot}3 \text{ per cent.}$$

In the discussion which followed the reading of Mr. J. E. H. Gordon's paper,

Mr. R. E. CROMPTON said, that the case Mr. Gordon

had taken was more simple than would be generally the case, as a large system would have to be fed from several points, in which case the calculation would become very complicated. If several centres for the supply of the electricity are employed, the saving in the cost of the mains is very considerable. The maintenance of a constant potential in the mains, under varying circumstances, was a most important element which should not be overlooked when planning a system of lighting. He thought the use of the "horse-power-hour" unit was not so convenient as the "1000-ampère hours" which had been recommended by the Board of Trade.

Prof. AYRTON said, that the preservation of a uniform potential in a system was a most important point, as a charge of less than 5 per cent. only produced a most perceptible effect on the light. Sir William Thomson had calculated that a square inch per 250 ampères for the copper conductor was an economical size, but this applied to the mains only. With reference to Mr. Gordon's apparatus for measuring the strength of a magnetic field, he pointed out that it did not enable the strength of the field to be measured when the armature was in its place. It did not at all follow that the field which was best when the armature was not in its place, was also the best field when the armature was in position.

Prof. FOSTER enquired why the coil was not caused to turn through half instead of one-quarter of a revolution; he thought if the former arrangement were adopted more trustworthy results would be obtained. If shunts were used for the galvanometer, it would, he pointed out, be necessary to make the correction which had first been pointed out by Mr. Latimer Clark; it would therefore be advisable to reduce the sensitiveness of the galvanometer to the required amount by the insertion of a resistance in the direct circuit rather than to employ a shunt.

Prof. HUGHES said that he had found it possible to measure the strength of a magnetic field by means of a "proof" armature, viz., a piece of iron held in the magnetic field and submitted to flexion, this caused the iron to become magnetised in proportion to the strength of the field.

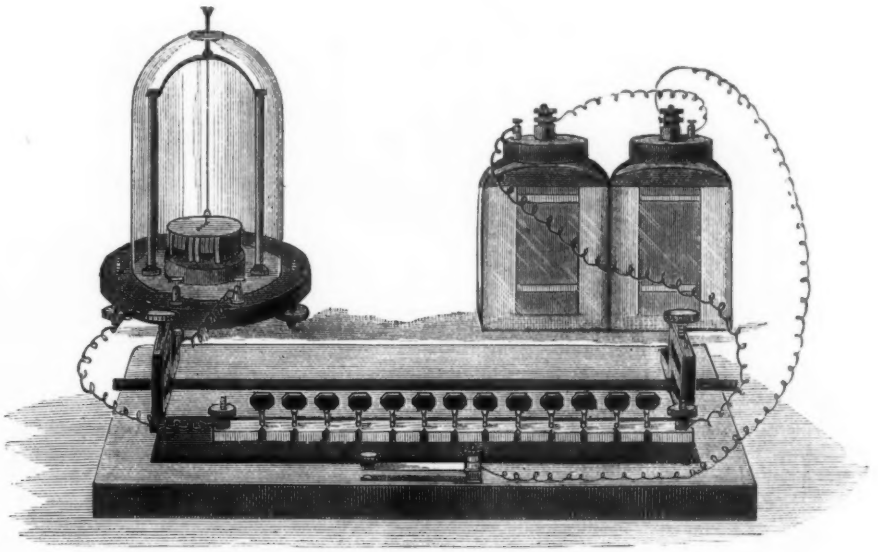
Mr. BLAKESLEY pointed out that a great number of items, beside the copper of the conductor, required to be considered in estimating the most economical conditions for a system of conductors; in fact, the copper was by no means necessarily the most important item.

Mr. GORDON, in replying, said that, with reference to the movement of the coil in his apparatus, it was found that in certain positions there was only space for a quarter revolution to take place. The correction for the shunts he did not consider necessary as only roughly comparative results were aimed at. Prof. Hughes' method of measuring the strength of a field was only applicable to weak fields. He pointed out that many of the criticisms on his paper on the "Measurement of the power expended in a conductor, &c.," were not justified, as the actual scope of the paper had been misunderstood.

The meeting then adjourned.

APPARATUS FOR TESTING CARBON RODS.

WE have, on more than one occasion, described and illustrated various ingenious and simplified apparatus for taking electrical measurements devised by Mr. Simmons. The arrangement shown in the figure below is not less worthy of publicity than the former productions of this now well-known electrical instrument manufacturer. The apparatus, which is specially designed for measuring the resistance of carbon rods of any diameter, consists of a base-board on which are placed a series of resistance coils varying from 0·01 to 10 ohms.

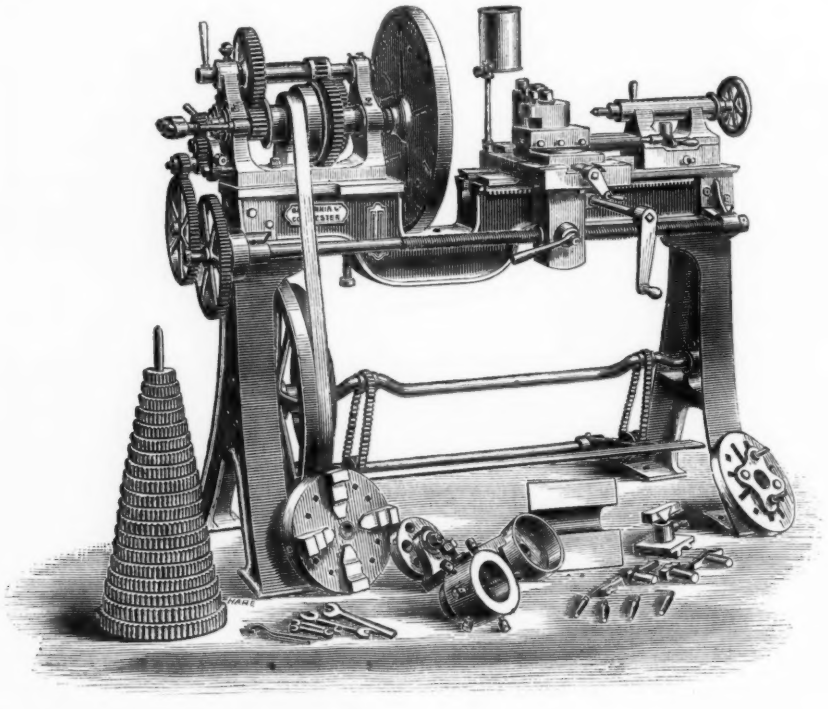


The proportional parts, for the coils are arranged as in a "Wheatstone bridge," are always in circuit, and are, therefore, placed out of sight. A battery contact key is fixed on the front of the base-board, and at the back are two massive metal clamps, one or both of which may be movable, for holding the carbon rod to be measured, as shown. The connection made by these clamps approximates closely to the contact made by the carbons when actually in their holders in an electric lamp. The galvanometer supplied with the test-board is of low resistance and highly sensitive, and it is specially constructed for its purpose. The whole arrangement is very neat and handy, and measurements may readily be taken by persons unversed in electrical matters, the operator's attention to the proportional parts being left out of the question. We have personally employed the apparatus and can testify to its usefulness.

The Late Sir William Siemens.—Mr. Meyerstein, a member of the Society of Arts, has undertaken a steel plate engraving from a portrait of the late Sir William Siemens. The engraving will be printed in 4to. imperial size. As soon as the plate is finished, proofs will be placed on view in the society's library, but members and others desiring to procure copies must communicate with Mr. Meyerstein, 280, High Holborn.

A SPECIALLY-DESIGNED FOOT LATHE.

THE cut below represents an extra strong lathe for foot-power, specially designed for the British Navy, and manufactured by the Britannia Manufacturing Company. The following brief description will enable our readers to become acquainted with the machine. The bed is 4 feet 6 inches long and $8\frac{3}{4}$ inches on face, $7\frac{1}{2}$ inches wide, and $6\frac{1}{2}$ inches deep; it will swing 2 feet diameter and 1 foot 8 inches long. It has three speeds on the cone, 9 inches, 6 inches, and 4 inches for $1\frac{1}{2}$ inch band. The head is fitted with treble gear, $\frac{9}{16}$ pitch, $1\frac{1}{2}$ face, and there are two eccentric shafts to alter the speed to either single, double, or treble gear. It has a steel leading screw $1\frac{1}{2}$ inch diameter, $\frac{1}{4}$ pitch. These lathes are especially designed to do very heavy work by means of the treble gear, by foot-power, where steam power cannot be obtained, and they are made with 3 feet 9 inches bed, 5 inches centre, or 4 feet 6 inches, as above described, for ironclads and torpedo ships, where space is limited. They are fitted with a full assortment of chucks and tools of corresponding strength, and may have longer beds when required. By using the double gear this will take a $\frac{1}{2}$ inch cut off a 2 inch or 3 inch shaft. The treble gear is used on larger articles up to 24 inches. As an instance of the work, a 24 inch wheel or plate can easily be turned by foot-power by use of the treble gear. The total weight of the lathe and tools is 14 cwt.



BROWN AND SAUNDERS'S TELEPHONE CALL APPARATUS.

THE object of this invention is to enable an operator at any one telephone station of a number of such stations in series on one line wire to call any one of the stations without disturbing the remainder. This is accomplished by taking advantage of a well-known property of pendulums, namely, that when the propelling impulses are small the pendulums will only oscillate continuously in response to impulses given at their own proper rate of oscillation. Reed vibrators have long been used for similar purposes, but in applying them to telephone signalling a difficulty occurs in consequence of variations in the currents. These variations arise in practice from a number of causes, but chiefly on telephonic circuits from the variation of the resistance of the circuit when the line is successively plugged through to a number of different lines. Then either the weaker currents fail to accumulate sufficiently ample oscillation in the reed vibrator, or else the stronger currents exercise too much control over the reed and bring it into operation when the next numbers are being called. More especially is this the case when the currents used are those produced by the magneto machines used in telephonic work; these currents being undulatory in their nature and being subject to external variations from variations of speed in turning.

From the above-mentioned and other causes reed vibrators are thrown into vibration even when the rate of succession of currents is made very considerably different to the proper rate of the reed. The invention of Messrs. Brown and Saunders, however, enables magneto machines, together with their own ordinary alarm bells, to be used.

At each station of a number in series on one line a pair of pendulums is placed, suspended in any ordinary manner, one for transmitting and the other for receiving.

The apparatus is represented by fig. 1. A is a board fixed in a vertical position, upon which the various parts of the apparatus are mounted. a is the transmitting pendulum; it is suspended from the knife edges, a^1, which are moved into V notches in the piece, b. The transmitting pendulum is actuated by a single impulse given to it by hand by the operator in calling. The impulse may be given directly or through the intervention of a lever key. The transmitting pendulum carries a movable bob, a^2, capable of being placed in any position by the operator, the proper positions for each station to be called being denoted either by notches cut in the pendulum rod or by a graduated scale placed behind. This pendulum makes and breaks electrical contacts by means of a light contact spring, a^3, extending out from the rod immediately below the knife edges. The spring, as the pendulum vibrates, oscillates between two adjustable contact points, c^1 and c^2. The relative duration of the make to the break is adjustable by turning the contact screws out or in.

The receiving pendulums, (*d*), are actuated by the current by means of an electro-magnet, *e*, at each station. The coils of these several electro-magnets are in series in the line circuit. The receiving pendulums each carry a bob, which is placed at a different position (or distance from the point of suspension) at each station on the line. (The positions to which the bobs of the receiving pendulums are set correspond in each case to one of the divisions on the scale for transmitting pendulums at every station, and the length of the receiving pendulum is such that it makes two vibrations to one of the transmitting pendulum.) When, therefore, the bob of a transmitting pendulum is placed at any particular height and the pendulum started, currents from any source are caused to flow through the contacts which it actuates and along the line, then these current impulses will only actuate that receiving pendulum whose normal rate of vibration is similar to that of the transmitting pendulum. The arc of vibration will be small at first, but will gradually increase until it becomes considerable. The other pendulums will simply, after making a few small oscillations, interfere and come to rest again. The receiving pendulum, which accumulates the oscillations, knocks against a piece of wire, *f*, projecting from a light contact spring, f^1, and lifts the spring off a screw stud, *g*, with which it normally makes contact. This contact when made closes a short circuit around the coils of the bell or call signal which is in series in the line circuit, and since this contact is broken by the receiving pendulum at a time when, by the operation of the transmitting pendulum, a current is on the line, the call will sound at each oscillation. f^2 is a weight or bob fixed on the spring, f^1; it causes the spring to oscillate for some time after receiving a blow from the pendulum, *d*, and so aids in keeping the circuit open through the bell. Or the pendulum rod may be made to open and close local circuits.

In order that the pendulum, *d*, may be influenced equally, or nearly so, by strong and by weak currents, instead of attaching the armature, *h*, to the pendulum rod, and allowing the electro-magnet, *e*, to attract the pendulum directly, the inventors suspend the armature from knife edges, h^1, and then suspend the pendulum rod proper to the bottom of the armature, either by a thin flexible blade or spring or knife edge, d^1. At the back of the armature there is an adjusting screw, *i*, by which its play can be limited to as small an extent as desired. The parts are so hung that gravity draws the armature back against the screw stop, *i*. Now, since the armature, *h*, is by this means always kept very close to the electro-magnet, the weakest current capable of working the apparatus at all (and much weaker than any likely to be experienced) will pull the armature right up to the magnet, while the strongest possible current can do no more, the surplus energy simply spending itself on the poles of the magnet. The armature also will, when sufficient time is allowed, come right back by gravity at every cessation of current produced by the transmitting pendulum.

The total effect of currents, whether weak or strong, therefore is simply to move the point of suspension of the pendulum through the same short horizontal distance, and thus the effect of varying currents is practically neutralised.

The use of the ordinary telephonic magneto call, therefore, producing a variable and undulating current (and in combination with its own ordinary magnetic alarm bell) is thus rendered practically feasible.

The principle of application of the apparatus for all telephone and telegraph systems is, however, the same, viz., that the calling currents are thrown on and off the line circuit by the making and breaking of the contacts by the transmitting pendulum, while the receiving pendulum when it accumulates the proper arc of oscillation knocks on one side a contact spring, and so either opens the circuit of an alarm bell or other signal placed in the line circuit, or else operates a local circuit and makes the signal by means of a local current. And the system is evidently applicable to any form of telegraph whose currents do not coincide in rate with that of any of the receiving pendulums.

FIG. 1.

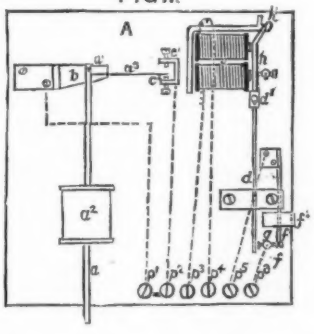


FIG. 2.

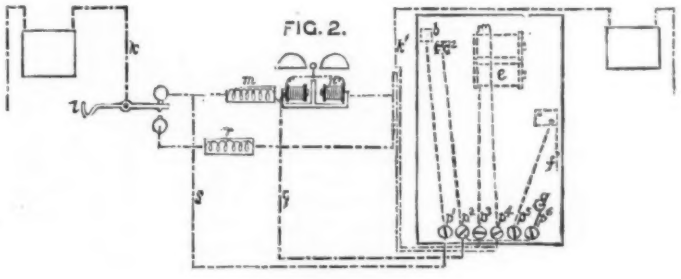


FIG. 3.

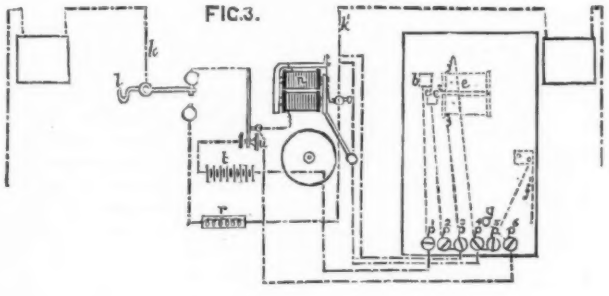
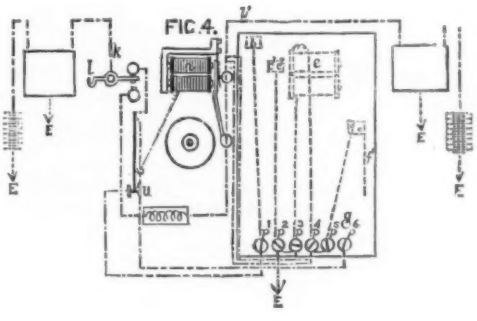


FIG. 4.



The arrangement at a telephone station is represented by fig. 2, and is as follows:—The line wire, *k*, on one side of the station is brought to the pivot of the telephone hook, *l*, and the hook on its upper contact completes the circuit through the magneto generator, *m*, and bell coils, *n*, and thence by the coupling, p^4, through the coils, *e*, of the receiving pendulum apparatus and coupling, p^3, again to line, k^1, on the other side of the station. The bell coils are, however, short-circuited by the connection, *q*, passing to p^2, thence to p^6, *g*, f^1, p^5, and p^4. On its bottom contact the telephone hook completes the circuit through the speaking and receiving telephones, *r*, and the receiving pendulum coils, *e*, again to line on the other side of the station by the

path already traced. The terminals of the magneto generator, *m*, are also coupled with the transmitting pendulum by the connections, *s* and *q*, passing to p^1 and p^2, which are coupled respectively with the part *b* and contacts, c^1, c^2, of the transmitting pendulum. When a^3 touches c^1 or c^2, the generator is short-circuited, but at other times the currents from it pass by p^2, p^6, *g*, f^1, p^5, p^4, *e*, and p^3, to line k^1. The bell is short-circuited as already described. When a battery, *t*, is used in place of the magneto generator, as represented in fig. 3, the ringing key, *u*, is between the upper contact of the telephone hook and the bell. The zinc of the battery is permanently connected with the transmitting pendulum apparatus, and the key when depressed leaves the contact which connects it with the bell and completes a contact which is coupled with the copper of the battery. The inventors prefer, however, as represented in fig. 4, to employ opposed batteries at the two ends of the line, in which case the key introduces an intermediate earth through the transmitting pendulum contacts.

ON A MAGNETIC BALANCE, AND EXPERIMENTAL RESEARCHES MADE THEREWITH.*

By PROF. D. E. HUGHES, F.R.S.

IN a paper "On the Molecular Rigidity of Tempered Steel,"† I advanced the theory that the molecules of soft iron were comparatively free as regards motion amongst themselves, whilst in hard iron or steel they were extremely rigid in their relative positions.

I have since widened the field of inquiry by observing the effects of mechanical compression and strains, as well as annealing and tempering, upon the magnetic capacity of sixty varieties of iron and steel, ranging from the softest Swedish iron to the hardest tempered cast steel.

We know already that soft iron will take a higher degree of temporary magnetism than steel, and that tempered steel retains magnetism more than soft iron; consequently, we might believe that by the aid of an instrument which should give correct measurements, we might be able to include all varieties of iron and steel between the two extremes of softness, as in annealed iron, and hardness, as in high-tempered cast steel. This proved, however, not to be the case, if the iron and steel were not all annealed to one absolute standard, and if magnetised to or near saturation.

In a late paper upon the theory of magnetism,‡ I said:—

"During these researches I have remarked a peculiar property of magnetism, viz., that not only can the molecules be rotated through any degree of arc to its maximum, or saturation, but that, whilst it requires a comparatively strong force to overcome its rigidity or resistance to rotation, it has a small field of its own through which it can move with excessive freedom, trembling, vibrating, or rotating through a small degree with infinitely less force than would be required to rotate it permanently on either side. This property is so marked and general that we can observe it without any special iron or apparatus."

In order to observe this in electro-magnets, we must employ an extremely feeble current, such as from one Daniell cell, with an exterior resistance of from 10 to 1,000 ohms, and we then find the following laws hold with every variety of iron and steel:—

1st. That its magnetic capacity is directly as its softness or molecular freedom.

2nd. That its resistance to a feeble external magnetising force is directly as its hardness, or its molecular rigidity.

This has proved to be the case upon sixty varieties of iron and steel furnished me direct from the manufacturers, and it was remarked that each variety of iron or steel has a certain point, beyond which annealing cannot soften, nor temper harden; consequently, if all varieties were equally and perfectly annealed, each variety would have its own magnetic capacity, or its specific degree of value when perfectly annealed or tempered, by means of which we could at once determine its place and quality.

If in place of several varieties we take a single specimen, say hard-drawn Swedish iron wire, and note its magnetic capacity, we find that its value rises rapidly with each partial annealing, until an ultimate softness is obtained; being the limit of its molecular freedom. We are thus enabled to study the best methods of annealing, and to find at once the degree of softness in an unknown specimen. A similar effect occurs in observations upon tempering; from the softest to the hardest temper, until we arrive at its ultimate molecular rigidity.

We have thus in each piece of iron or steel a limit of softness and hardness. In soft Swedish iron tempering hardens but 25 per cent., whilst mechanical compression (such as hammering) hardens it 50 per cent. In cast steel, tempering hardens it 400 per cent., whilst mechanical compression gives but 50 per cent. Between cast steel and Swedish iron we find a long series of mild steel and hard iron, varying in their proportionate degree between the two extremes mentioned.

In order to carry out these researches, I constructed an instrument which I have called the magnetic balance. It consists of a delicate silk fibre suspended magnetic needle, 5 centims. in length, its pointer resting near an index having a single fine black line or mark for its zero, the movement of the needle on the other side of zero being limited to 5 millims. by means of two ivory stops, or projections. When the north end of the needle and its index zero are north, the needle rests at its index zero, but the slightest external influence, such as a piece of iron 1 millim. in diameter 10 centims. distant, deflects the needle to the right or left according to the polarity of its magnetism, and with a force proportional to its power. If we place on the opposite side of the needle at the same distance a wire possessing similar polarity and force, the two are equal, and the needle returns to zero, and if we know the magnetic value required to produce a balance we know the value of both. In order to balance any wire or piece of iron placed in a position east and west, a magnetic compensator is used, consisting of a powerful bar-magnet free to revolve upon a central pivot placed at a distance of 30 or more centims., so as to be able to obtain delicate observations. This turns upon an index, the degrees of which are marked for equal degrees of magnetic action upon the needle.

A coil of insulated wire, through which a feeble electric current is passing, magnetises the piece of iron under observation, but as the coil itself would act upon the needle, this is balanced by an equal and opposing coil on the opposite side, and we are thus enabled to observe the magnetism due to the iron alone. A reversing key, resistance coils, and a Daniell cell is required. Great care must be taken so that the electromotive force remains a constant, as a small variation in the electromotive force gives large variations in the readings, and many important details of construction are required, in order that it shall give perfect readings for extremely small magnetic force. Still greater care is required that each specimen of iron or steel shall be annealed to its maximum.

Several methods of observation have been employed with the magnetic balance, the usual one being the one described, but interesting results are attained by observing the influence of earth's magnetism alone on the iron or steel, or we may magnetise all specimens to the same value, and note the amount of current required. We may observe the remaining magnetism after the cessation of the current or the influence of a weak current after the passage of a strong magnetising force. These are more applicable to researches upon the cause of magnetism.

* Proceedings of the Royal Society, December 1883.

† "Proceedings Institution of Mechanical Engineers," January, 1883.

‡ Society of Telegraph Engineers, May 24, 1883.

By means of this instrument I have tested 60 varieties of iron and steel, mostly in the form of wires, a wire 1 millim. diameter, 10 centims. long, being the standard used. In all comparative experiments we require one standard form, to which all the rest must be similar in form and size; at present, we cannot readily compare a square or flat bar with a piece of wire, but if all pieces have the same form, and all are annealed to the same standard, then any difference observed between them must be due to their comparative softness, from which we can deduce its quality and place on the line from soft iron to cast steel.

Annealing not only produces softness and consequent molecular freedom, but it entirely frees it from all strains previously introduced by drawing or hammering. Thus a bar of iron drawn or hammered has a peculiar structure, say a fibrous one, which gives a greater mechanical strength in one direction than another. This bar, if thoroughly annealed at high temperatures, becomes homogeneous, and has no longer even traces of its previous strains, provided that there has been no actual mechanical separation into a distinct series of fibres.

TABLE I.

INFLUENCE OF ANNEALING UPON SWEDISH IRON, SAMPLE G.

	Degrees of softness indicated upon the magnetic balance.
Wire, hard drawn, as furnished by the makers ...	230°
Annealed at black heat	255°
„ dull red	329°
„ bright red	438°
„ yellow	507°
„ yellow-white	525°

From the above table, we notice that a regular increase of softness occurs, as the temperature at which it is annealed increases, the maximum being at a point under that of fusion.

Numerous methods of annealing were tried, the highest results being obtained when the iron or steel was heated as rapidly as possible to a high temperature, and cooled in a neutral surrounding or atmosphere. The facts regarding annealing as pointed out by the measurement of the magnetic capacity of iron, have, no doubt, been in great measure perceived by ordinary mechanical methods; the results of my own researches may be thus formulated :—

1. The highest degree of softness in any variety of iron or steel is that obtained by a rapid heating to the highest temperature less than fusion.

2. The time of gradual cooling required varies directly as the amount of carbon alloy.

Thus in chemical pure iron, rapid cooling, as in tempering, would not harden it, whilst steel might require several days, even for pieces only 1 millim. diameter. Slow cooling has no injurious effect upon pure iron when cooled in a neutral surrounding, consequently, where time is no object, we may employ slow cooling in every case.

A wire or piece of iron, thoroughly annealed, must not be bent, stretched, hammered, or filed, as the hardening effects of a bend are most remarkable, and the mere cleaning of its surface by sand paper hardens its surface several degrees.

The following table shows the effect of annealing upon a series of wires, kindly furnished me expressly for these experiments by Messrs. Frederick Smith & Co., of Halifax :—

TABLE II.

Marked.		Magnetic capacity.	
		Bright hard drawn.	Annealed.
G	Best Swedish charcoal iron, 1st variety	230	525
F	Best Swedish charcoal iron, 2nd variety	236	510
T	Best Swedish charcoal iron, 3rd variety	275	503
S	Swedish, Siemens-Martin, iron...	165	430
H	Puddled iron, best best	212	340
Y′	Bessemer, soft steel	150	291
Y	Bessemer, hard steel	115	172
Z	Crucible fine cast steel	50	84

The above series contains representative irons and steel of all classes, all other varieties yet tried stand between cast steel and Swedish iron, generally classed as hard cast steel, hard steel, mild steel, hard puddled iron, soft iron, Swedish charcoal iron.

From the above table it will be seen that every wire rises greatly in value by annealing, and that we could not estimate the true magnetic capacity of any iron or steel unless special attention was given that all should be annealed to their maximum.

The influence of tempering upon the magnetic retentivity or molecular rigidity has been shown in every piece of iron or steel examined, the molecular rigidity of tempered cast steel being proportional to its species of temper as shown in Table III.

Table IV. gives the complete results of the mechanical, chemical, and physical tests upon a series of wires furnished by Messrs. Frederick Smith & Co., of Halifax.

TABLE IV.

Marked.		Electrical Resistance per mile of 400 diameter.	Tensile strength per square inch.	Magnetic Capacity.			Chemical Analyses.						
				Bright hard drawn.	Annealed.	Tempered hard.	Carbon.	Silicon.	Sulphur.	Phosphorus.	Manganese.	Copper.	Iron.
		ohms.	tons.										
G	Best Swedish charcoal iron 1	191·52	28	230	525	435	0·09	trace	trace	0·012	0·06	trace	99·69
F	„ „ 2	198·40	30	236	510	415	0·10	trace	0·022	0·045	0·03	trace	99·70
T	„ „ 3	199·62	31	275	503	395	0·15	0·018	0·019	0·058	0·234	trace	99·44
S	Swedish Siemens-Martin iron	226·32	34	165	430	390	0·10	trace	0·035	0·034	0·324	trace	99·60
H	Puddled iron, best best	259·92	30	212	340	328	0·10	0·09	0·03	0·218	0·234	0·015	99·11
Y′	Best homogeneous soft Bessemer steel	266·52	35	150	291	255	0·15	0·018	0·092	0·077	0·72	trace	98·74
Y	„ hard „	312·69	50	115	172	60	0·44	0·028	0·126	0·103	1·296	trace	98·20
Z	Fine crucible cast steel	350·08	55	50	84	28	0·62	0·06	0·074	0·051	1·584	trace	97·41

TABLE III.

TEMPERING.

	Magnetic capacity.
Crucible fine cast steel, tempered	
Bright yellow heat cooled in cold water	28
Yellow red „ „	32
Bright yellow tempered in cold water let down to straw colour	33
Bright yellow tempered in cold water let down to blue	43
Bright yellow tempered in oil	51
Bright yellow tempered in water let down to white ...	58
Red heat tempered in water...	66
Red heat tempered in oil	72
Crucible cast steel annealed	84
Swedish charcoal iron annealed	525

The tensile strength and electric conductivity are those furnished me by Messrs. Smith & Co. The chemical analyses by Mr. Henry S. Bell, of Sheffield, the magnetic capacity of the bright hard drawn, annealed, and tempered wires, were determined by myself by the aid of the magnetic balance.

In the above Table IV there is a complete relation between electric conductivity and magnetic capacity, both progressing in a similar ratio and agreeing in a most remarkable manner.

We see here that the electric conductivity and magnetic capacity have a complete relation to each other, but whilst in every wire measured I have found this true, it is only so when the wire has been completely annealed and free from mechanical strain, and a feeble magnetic force employed, thus the relation exists only in the limited sphere of elastic rotation already mentioned.

I believe that the relation here shown between electric conductivity and magnetic capacity to be of importance in theoretical considerations, and of some practical utility, as we can at once find the electric conductivity of iron and steel from a simple reading of its magnetic capacity, and also show the iron most suitable for the cores of electro-magnets.

CARDEW'S VOLTMETER.

THIS voltmeter, the invention of Lieut. Cardew, R.E., is a novel adaptation of an old principle which has been more than once employed for the measurement of current strength. The new instrument, which is equally applicable to alternating or continuous currents, is shown by the figure ; it consists essentially of a very fine platinum silver wire, ·0025 inch in diameter, enclosed in a brass tube. The difference of potential to be measured is applied at the ends of the wire, which is heated by the current passing through it. The wire expands on being heated, but is kept stretched by a spring or weight, and the expansion is indicated by suitable apparatus.

The inventor explains the action of the apparatus as follows :—The heat produced in any conductor (not containing an electromotive force) by any difference of potential applied to the ends is equal to $\frac{V^2}{R}$ per unit of time, where V is the difference of potential in volts, and R the resistance in ohms. The resulting temperature of the conductor for any difference of potential depends on the temperature and the rate of motion of the particles of the surrounding medium. It will be seen from this that the absolute stretch of the wire, which would accurately measure its rise of temperature, would not be an accurate measure of the current passing through it, or of the volts producing that current. Even when no current was passing the instrument would not maintain an accurate zero, since alterations of atmospheric temperature would affect it.

These defects are obviated by the use of the brass tube enclosing the wire.

The coefficient of expansion of brass for temperature is sensibly the same as that of platinum silver. Hence, so long as they are both at the same temperature, the zero is unaffected by any alteration of it, or the variations in length of the wire are compensated. When, however, a current is passed through the wire, its temperature is raised above that of the surrounding tube, and a perfectly regular current of heat is established between the wire and the tube, since all external draughts are prevented. It is therefore the difference of temperature between the wire and the tube that is measured, and this is necessarily constant for the same difference of potential, except for the fact that the resistance of the wire varies slightly with its temperature.

This variation in the resistance has the effect of causing the reading for any volts to be slightly higher on a cold day than it is on a warm one, but as the alloy of platinum and silver used only varies ·035 per cent. per degree centigrade, this error is not worth consideration as long as the surrounding air is at an ordinary temperature.

The considerations guiding the choice of a wire for the purpose were as follows :—

1. It must absorb a minimum of energy, therefore the wire should be as fine as possible and of a high specific resistance.

2. It must follow all variations in the volts with extreme rapidity, and must therefore be formed of a metal of low specific heat and must offer a large surface for its mass.

3. The material must not be liable to oxidation even at a high temperature.

4. The coefficient of variation of resistance for temperature must be very small.

5. Its elasticity and tensile strength must be high. A fine platinum silver wire best answered these conditions.

The instruments are practically instantaneous in their indications and quite dead beat.

Having determined by these considerations the most suitable material and size of wire, the next point to determine was the number of volts that could safely be put on any length of it. With this view one foot of the wire was taken and the number of volts required to make it just visibly red in a dark room determined to be 21. As the rise of temperature for any volts varies as V^2 it is evident that 10 volts would only raise one part to rather less than $\frac{1}{4}$ the amount required to redden it. Experience has shewn that this rise does not permanently alter the wire.

The working maximum number of volts is therefore taken at 10 per foot. For 200 volts, therefore, 20 feet of the wire is required, but this length need not necessarily be contained in the instrument, although it is advisable to use the same kind and size of wire throughout.

The instruments are generally made to work to 120 volts, and a sufficient length of wire is supplied in a metallic box to extend the readings to any required number of volts.

As the current strengths are not directly proportional to the degrees of deflection of the needle, a diagram is provided with each instrument, showing the relative proportions between the two.

For ordinary purposes it is quite sufficient to extend the limits to which the instrument will measure by putting an incandescent lamp in circuit with it. Thus an instrument for 120 volts has a resistance of about 360 ohms, and if an Edison lamp be added it will easily read to 200 volts.

In order to save the instrument from fusion by excess of current a safety fuse is placed in the circuit. This consists of a short length of finer platinum silver or iridium platinum wire.

The advantages claimed for this form of voltmeter are :—

1. That it is more reliable than any instrument dependent on permanent or temporary magnetism.

2. It is totally unaffected by the most powerful magnetic field, and the reading is always that exactly due to the current being measured.

3. It is equally applicable to alternating or continuous currents.

4. That the reading instantaneously follows any variation of current and is quite dead beat.

That it is extremely simple in principle and construction, and if broken can be repaired at a trifling cost.

We may add that the instrument, which is patented, is manufactured by Messrs. Paterson & Cooper, of Little Britain.

NOTES.

Electric Lighting.—The city of Leadville, Col., is to be lighted by electricity, and the wires are to be run underground.

The Navy Department of the United States has received three new electric search lights from France. Two have been placed on the United States steamship *Trenton*, and the other will be used at the torpedo station, Newport. It is said to be likely that these lights will be adopted for general use in the navy.

The Elphinstone-Vincent dynamo-electric machine, which we have described and illustrated at considerable length, appears to have attracted no little attention at the late Electrical Exhibition in Vienna. The Crown Prince and Princess were much interested with its performance, and the Prince requested the representative of Lord Elphinstone to explain to him fully its construction. On alternate evenings the machine was employed for supplying the current for 400 Woodhouse and Rawson incandescence lamps, and a search light of 200,000 candle power, respectively.

The Junior Army and Navy Co-operative Society, Limited, has just introduced the electric light on three floors of its premises, York House, Regent Street. The installation consists of 75 "Gatehouse" incandescent lamps of 20 candle-power nominal each, the current being derived from a D^2 Siemens' dynamo machine, driven by a 16 H.P. "Otto" gas engine. The work has been carried out under a contract by Mr. Fred. Croker, of 9, Margaret Street, W., the dynamo machine and lamps being supplied by the "Pilsen" "Joel" and General Electric Light Company, Limited. The order for the lamps and dynamo machine was delivered to that company on the 12th inst., at 12 o'clock noon. The machine was tested at the company's factories, by Mr. Croker's electrician, at 2 p.m. on that day, and the installation was running satisfactorily on the 15th inst. The management of the Co-operative Society is to be commended for the enterprise it has shown in this matter, these being, we believe, the first co-operative stores in London in which the electric light has been adopted.

Messrs. John Elder & Co., Govan, have lately had erected in their shipbuilding yard an installation of 17 Brush arc lamps, dynamo, &c. The contract was undertaken and carried out by Mr. E. W. Beckingsale, C.E., Glasgow. The lamps are suspended at heights of from 30 feet to 60 feet in exposed positions over the frames and decks of the ships on the stocks, which rendered the obtaining of a good insulation resistance of the circuit a matter of some difficulty; precautions were taken to prevent loss of current, and the consequent defective burning of the lamps and waste of power, by covering the woodwork of the lamps, which had been previously well dried, with shellac varnish, and those parts which form the shortest route between the poles had the additional protection of a second layer of shellac and paraffine wax. On testing the circuit, consisting of a mile and a quarter of gutta-percha insulated wire and 17 lamps, on a wet day, a resistance of ·4 of a megohm was obtained by deflection. The battery, unfortunately, consisted of but 10 cells. The copper resistance of the line with carbons and all contacts was 67 ohms, which is low, but is accounted for by the carbons being hot at the time of the test, and consequently making good contact. The insulation test, which was taken at the same time, was probably influenced by the strong lighting current just taken off. The raising and lowering of the lamps are effected by rope and pulley; the lower end of the cord is attached to the frame, and forms a guide as the lamp is lowered, but on account of this part being in the circuit, an insulation is interposed in the shape of an inverted hollow wooden cone filled with paraffine wax, which form an efficient cut-off to the current. Below this cone a prong stands out from the cord, and embraces the lamp standard, when the former is made fast and the lamp in position. The lamps burn well and give satisfaction.

Messrs. J. H. Holmes & Co., electric light engineers, of Westgate Road, Newcastle-on-Tyne, have lately completed a very satisfactory installation at a new café recently opened at Wallsend-on-Tyne. The installation comprises two dynamo-electric machines, driven by means of a six-horse power Tangye vertical engine, supplied with steam from a large vertical boiler; the engine is mounted on the same bed-plate as the boiler, and is provided with a high speed Pickering governor. The larger machine is a Siemens S D^2 self-regulating dynamo, and furnishes the requisite current for sixty 20-candle power Swan lamps, arranged on specially designed fittings in the café proper, the news-room, billiard-room, game-room, halls and staircases. The fittings, which are mostly combined gas and electric, comprise six electroliers of a chaste and elegant design, together with a substantial six-light billiard pendant, a number of single light brackets, and round the windows of the café runs a massive tube, carrying at intervals fifteen special brackets, together with gas jets to be used in the early morning, when the machinery is not running. On the outside front of the building are placed two arc lights in spherical lanterns, supported by means of hinged brackets in such a way that they may be swung round in front of a window, from which they may be reached for the purpose of renewing the carbons, &c., thus doing away with any need for ladders or hoisting apparatus. Arrangements are made for hanging one of these lamps when required in the concert hall, which forms part of the building, and when thus used it is found to light the room admirably. It is also intended to use this lamp for working a magic lantern in the hall when required, for illustrating lectures, for school treats, and such like occasions. Amongst the novelties of this installation may be mentioned an arrangement by which the electric current is utilised for the simultaneous lighting of the sun-burners in the ceiling of the concert hall. This is done by small coils of platinum wire near each burner being rendered incandescent, the circuit being completed through them on pressing a push similar to those used for electric bells. The Arc lights are supplied from a small alternating current machine, driven from the fly-wheel of the engine. Both lamps are of Siemens' differential type and burn very steadily.

Last week an industrial exhibition, opened by Lord Shaftesbury, was held at Ringwood. As an addition to other attractions the building was lit at night by six Pilsen arc lamps. The current for these was generated by one of the Pilsen Company's new-type machines, travelling at the slow speed of 600 revolutions, and driven by a portable engine placed close to the building. The size of the latter being only 75 ft. × 40 ft., the effect of the lamps, which burnt with the usual steadiness of the Pilsen arc lamp, was very good. The installation was made by Messrs. Woodhouse & Rawson, who also showed in the exhibition specimens of their incandescent lamps, switches, safety junctions, leads, and other electrical appliances. Considerable interest was shown in a small battery lighting up a surgical lamp for dentists' purposes, with resistance coil, and also surgical lamps for inserting down the throat. These lamps are kept cool by being in a small water tube.

The first town in Switzerland to be entirely lighted and have its tramways driven by electricity will be Montreux, on the Lake of Geneva, a company having obtained a concession for the purpose. The motive power is derived from the water of the lake. Extensive works are to be erected immediately.

Overhead Wires.—At the Wandsworth Police Court on Friday last week, the dispute between the Post Office authorities and the Wandsworth Board of Works, with reference to the erection of overhead telegraph wires in several circuits in the district, again came on for hearing. The Board objected to overhead wires on account of danger to the public, but the Post Office authorities would not consent to place them under ground in consequence of the great expense which would have to be incurred. Mr. Paget inquired of the parties whether they had come to any agreement. Mr. Corsellis, clerk of the Board, said nothing further had taken place, but he was instructed to state that two accidents had recently occurred, one in Roehampton Lane, and the other in the country. The magistrate was the authority to decide the matter. He was instructed to ask, if the magistrate intended to decide it, to be allowed to call evidence in the case of each wire. The Board had decided that the responsibility must rest upon the magistrate entirely. Mr. Paget then intimated his intention of hearing the case, and said he should require the particular points specified. Mr. Casserley, who appeared in support of the summonses, said the Post Office authorities were most anxious to have a decision, but he thought it was not fair to the magistrate and the Board to have the matter dealt with in that way. Mr. Paget observed that all he could do was to obey the Act of Parliament. If they wished to have a special time appointed an application must be made to the Home Office. Mr. Casserley said nothing short of a special day would be of any use to the department. He had just been informed that the police authorities required them to remove their wires from that building to the new station, which they intended to open on Monday, and any delay might cause public inconvenience. Mr. Paget said he was very sorry for it. The public had been put to a great inconvenience at that court for a long time. The summonses were then adjourned for a fortnight.

Telegraphy as a Means of Fire Alarm.—The superintendent of the Bolton Corporation Fire Brigade has recommended in his annual report that a system of telegraph stations be established in the borough, any one of which may be taken advantage of in case of a fire. He has suggested that there be nine of these stations in the several parts of the town, and that each one shall be fixed in a wall with a small window, showing the means of communication with the central office, the glass to be broken in case of an outbreak, and the alarm then rung in the usual way. Instead of a bell in the fire-engine house, he would have an index finger showing the quarter from whence the alarm came. Telephonic communication has been opened in connection with several large cotton mills and the fire offices, but its adoption does not seem likely to be general at present, the majority of firms retaining the telegraphic service direct, instead of a telephonic one through an exchange. Within the past few weeks the superintendent and the brigade have "turned out" twice, only to find the alarms false ones, the explanation being that the wires extending from the works to the engine station have been affected by contact with foreign objects. It is to obviate this unpleasant experience that the superintendent seeks to establish street stations having direct communication with him.

The Jubilee of the Electric Telegraph in Germany.—Germany, says the *Frankfurter Zeitung*, celebrates this year the jubilee of the founding of the electric telegraph, for it was in 1833 that the first telegraphic communication was established by Gauss and Wilhelm Weber, of Göttingen. After expatiating at some considerable length on the vast usefulness of the telegraph throughout the world, the *Frankfurter Zeitung* concludes by saying, that the number of telegrams sent every year averages 170,000,000.

Revenue of the Telegraph Service.—The receipts for the Telegraph Service from the 1st April to 22nd December, 1883-4, has been £1,280,000, against £1,240,000 in the corresponding period of the previous year. The estimate for the year is £1,750,000.

The New Patent Act.—In a recent article which appeared in our pages on the new patent law, attention was directed to the fact that as the effect of one of its most useful provisions, the system of granting patents to persons for inventions communicated to them by other persons abroad was abolished. We observe, however, that this most salutary provision is rendered nugatory by the rules which have just been issued, as an application form has been drawn up, which by evading the spirit of the act whilst adhering to its letter, enables parties other than the inventors to obtain patents in this manner as heretofore. We understand that this change is the result of representations made to, and strong pressure brought to bear upon the Board of Trade. We shall probably recur to the subject on a future occasion.

Patents, &c., Act, 1883.—No applications under the new Patents, &c., Act will be accepted if they bear a date prior to the 1st January, 1884, the day upon which the Act comes into operation. Copies of the rules under the Act can be purchased at the Patent Office, Sale Department, Cursitor Street, Chancery Lane. It will not be possible to place the forms for applications under the Act for sale at various Post Offices before the 29th December, but any persons, if they think fit, may prepare forms in manuscript in conformity with the rule.

The Philadelphia Electrical Exhibition.—To meet the expenses of the International Electrical Exhibition, to be held in Philadelphia next year, fully $50,000 will be needed, and $30,000 have already been subscribed. The block comprising from Thirty-second to Thirty-Streets, and from Lancaster Avenue to Foster Street, has been secured. The site was partly tendered by the Pennsylvania Railroad Company, and it is within a few squares of the Market Street bridge, which will make it accessible from all quarters by both the street and steam cars.

Hammond Electric Light and Power Supply Company, Limited.—We are requested to state that the business of the Yorkshire Brush Electric Light and Power Supply Company, Limited, and of Messrs. Ferranti, Thompson, and Ince, Limited, will in the future be carried on by the Hammond Electric Light and Power Supply Company, Limited, with which the above mentioned Companies are now amalgamated; and also that Mr. Thomas Smith has been appointed agent and representative for Yorkshire, the Yorkshire Office being at 1, East Parade, Leeds.

British Electric Light Company, Limited.—This company will apply in March for a prolongation of the term of sole using and vending the patents of Z. T. Gramme and E. L. C. D'Ivernois, of Paris, for improvements in magneto-electric machines within the United Kingdom, the Channel Islands, and the Isle of Man.

Sir William Grove's "Correlation of Forces."*—We desire to call the attention of our readers to a work which, though universally known, is not so much read by electricians as it deserves to be. The "Correlation of Forces," by Sir William Grove, is printed, together with his experimental investigations, in one volume, to which an appendix has been lately added. Sir William Grove formed one of the distinguished band of discoverers by whom the law of the conservation of

* "The Correlation of Physical Forces." By the Hon. Sir William Grove. London: Longman, Green & Co.

energy has been established, and his work on the conservation of force still remains a standard authority. The various experimental investigations contained in this book deal with every sort of subject, as, for example, the experiments which led to the discovery of Grove's battery, the reasons why amalgamated zinc is undissolved with an unclosed circuit, etching by means of the voltaic pile, gas batteries and accumulators, voltaic ignition, and kindred matters. It is, however, not alone on account of the matter contained in it, that this book is to be recommended. It is a perfect example of an elegant scientific style of writing. The simplicity and clearness with which the experiments are described, and the logical order of the reasoning which leads to them, make the work invaluable as an example for students, and render it worthy to be classed in the highest rank of scientific writing. We hope this notice may induce some of our readers to study the works of Sir William Grove, and feel confident that we shall obtain their thanks for our recommendation. No one, however great his scientific knowledge, can rise from the perusal of a work like the "Correlation of Forces" without having obtained valuable and suggestive information, and, at the same time, received a lesson in the art of scientific exposition.

Electricity and Railroads.—In a speech made, as president of the Engineers' Club, Philadelphia, Mr. Hering stated that "the United States contains to-day 116,000 miles of railroads, and is building over 30 miles per day, and earning 550 dollars per mile. Locomotives for the Pennsylvania Railroad are made weighing over 60 tons, and run 90 miles in 80 minutes. Electricity is a competitor, which, however, is not likely at present to displace steam on the rail."

Schlaefli's Electric Clock.—An electric clock has been patented by Mr. Jean Paul Arnold Schlaefli, of Soleure, Switzerland. The invention relates to an improved secondary electric clock to be actuated by a weight raised periodically by a current at frequent intervals from a central station. The clock has no pendulum or balance wheel to regulate its rate of going, but is dependent solely upon the current transmitted, the minute hand being moved at minute intervals over minute spaces.

On the Retardation of the Demagnetisation of Iron by the Induction Currents Produced in its Interior.—By E. Stracciati.—According to the method already employed by Felici, the author obtains the following results for iron rods of 252 — 485 *mm.* long and 13 — 32 *mm.* thick, iron wires of 100 — 300 *mm.* long and 1 — 1·5 *mm.* thick, and slender iron rods of 4·5 — 8 *mm.* in thickness, steel blocks and steel tubes; if the iron mass is demagnetised in presence of two open coils, a magnetising and an inducing, the deviations of a galvanometer connected with the latter spiral ensue a certain time, *t*, after the opening of the magnetising current, according to the formula $F = A e^{-at}$, if the iron has no coercitive power. If it is not absolutely soft, then, as in the case of steel, the formula is—

$$F = A e^{-at} + B e^{-\beta t}.$$

The first formula is the more correct in proportion as the magnetising power is feebler. With the increase of the magnetism the rapidity of its disappearance diminishes at first very rapidly, and then by degrees more slowly. If induction currents are formed in the iron mass the disappearance of the magnetism is greatly retarded.—*Wiedemann's Beiblätter.*

NEW COMPANIES REGISTERED.

Buckley & Company, Limited.—Capital £1,250, in £25 shares. Objects: to take over and continue the business of Buckley & Co., of 7, Caroline Street, Birmingham, general electro-metallurgists, electro-platers, and gilders. Signatories (with 1 share each), G. E. Fletcher, W. Jennens, A. S. Openshaw, L. H. Elkington, A. H. Elkington, and S. A. Elkington, all of Birmingham, and J. Jennens, 7, Upper Wimpole Street, London, W. Registered 18th inst., by Messrs. Robinson & Co., 35, Lincoln's Inn Fields.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

British and Foreign Telephone Company, Limited.—An agreement, dated 11th inst., and filed on 22nd inst., has been adopted by this company for the purchase from Mr. George Shenton, of 5, Belsize Crescent, the invention of Mr. Charles Stetson Steele, of Washington, U.S.A., relating to improvements in telephonic apparatus, for which provisional protection, dated 2nd July, 1883 (No. 3,271), has been granted. The purchase consideration is £40,000 in fully-paid shares of £1 each.

South-Eastern (Brush) Electric Light and Power Company, Limited.—The annual return of this company, made up to the 11th inst., was filed on the 22nd inst. The nominal capital is £100,000 in £5 shares, the whole of which have been taken up. Upon 19,600 shares £1 10s. per share has been called up, and the full amount upon the remaining 400. The calls paid amount to £31,400, making the paid-up capital £100 in excess of the amount recorded as paid-up in last year's return. Registered office: 110, Cannon Street.

Brush Midland Electric Light and Power Company, Limited.—The annual return of this company, made up to the 12th inst., was filed on the 22nd inst. The nominal capital is £250,000 in £5 shares. 22,252 shares have been taken up, and upon the ordinary shares £2 10s. per share has been called, the shares issued to the vendor being considered as paid up in full. The total calls paid amount to £39,802, and considered as paid to £18,000, leaving £6,083 of calls unpaid. £255 has been paid in respect of 170 shares forfeited. The paid-up capital is £8,352 in excess of the amount recorded in the previous return. Registered office: 4, Great Winchester Street Buildings.

PARTNERSHIP DISSOLVED.

Riddell, Harry Gordon, and **Shaw, James,** electrical engineers, 9A, Parr Street, Liverpool. 22nd December, 1883.

CITY NOTES, REPORTS, MEETINGS, &c.

Indian and Oriental Electrical Storage and Works Company, Limited.

An extraordinary general meeting of this company was held at the Cannon Street Hotel, on Friday last week, when, however, the attendance of shareholders was very small.

Mr. Ernest Noel, chairman of the Board of Directors, presided, and called upon the secretary, Mr. H. Cleland Heywood, who read the notice convening the meeting.

The Chairman then said: In moving the resolution, of which you have all had notice, I shall only say a very few words, and reserve the majority of my remarks for the general meeting, which is to follow this, when the future conduct of the company will be spoken of. As regards this resolution which I invite you to pass today, the only effect of it is that the £50,000 worth of shares, that is 10,000 shares, that we were bound under agreement to give to the parent company, will, instead of being as they are now, ordinary shares, be deferred as to accumulative dividend; only 5 per cent. has been paid on the other shares, and no dividend will acrue by them. I think everybody will see that, supposing the company is successful—moderately successful—this is a great advantage, because, in view of the difficulties that impede electrical progress, we cannot anticipate very large results immediately—and that being the case, to be relieved of paying dividend on £50,000 is a very important matter. As regards the rest of the agreement we have made with the parent company in conjunction with making these shares deferred, but which does not come into question at a general meeting, because we have power to do it, we have made arrangements with them to have a new patent of an improved form of accumulator; and here let me point out one fact which I think there is a mistake about in the minds of some shareholders; and that is this: We suppose we have the right to all improvements on accumulators. This is perfectly true as regards the Sellon-Volckmar patent; but the accumulator we hope to obtain is not an improvement on the Sellon-Volckmar; no doubt it includes the Faure, but not the Sellon-Volckmar, and therefore we have no claim whatsoever

upon this new accumulator; we could not enforce any claim upon it whatsoever. We should have been without it had we not made the arrangement which we did some time ago by which we obtained the Faure patents, which we had not originally. When we went into this at first we purchased the Sellon-Volckmar, and those were all; but when I found that the Faure patents were more or less liable to oppose us, and that the parent company was going to obtain those Faure patents, I made the most strenuous exertions to obtain them for this company; we did obtain them, and all we paid was paid in advance, and was what we should otherwise have had to pay by small driblets as the company went on. If we had not obtained those patents, in my opinion, we should not now be able to become the possessors of the new accumulators, which, there is no doubt, obviates a very large number of the difficulties that we have found in working the Sellon-Volckmar patents in India, but that, as I said will be a subject to go into more fully at the general meeting. This is a resolution which clearly puts the shareholders in a very much better position with regard to almost one-half of the paid-up capital, and, therefore, I conceive that there can hardly be two opinions as to the mere passing of the resolution which I now beg to move.

Mr. Bullivant seconded the resolution.

Mr. Bedford said he did not know why this extraordinary general meeting should be called before the general meeting, and he would move an amendment "That this meeting be postponed until after the general meeting."

Mr. Banbury seconded the amendment.

The Chairman said as this course would be perfectly legal he had no objection to it; it was therefore agreed to.

The Secretary then read the notice convening the general meeting, and the minutes of the previous one.

The report which was circulated amongst the shareholders, ran as follows:—

The directors submit the balance-sheet of the company up to the 30th November, 1883, and they add the following explanation as to its position at that date.

The whole of the first issue of 40,000 shares has been alloted, except 5,000 which are payable to the Electrical Power Storage Company, as portion of the consideration for the purchase of their patents, and will be issued to them immediately upon completion of agreement now being entered into, for receiving the patent of a new type of improved accumulator, which the Electrical Power Storage Company has agreed to obtain for this company without any further charge.

The liabilities of the company were the paid up capital; a sum of £5,000, being balance of £25,000 payable in cash to the Electrical Power Storage Company on account of royalties, which sum was due in August last, and will be immediately discharged on completion of pending agreement as before mentioned; and a further sum as shown in the balance-sheet, amounting to £1,300 13s., of which the greater portion consists of a nominal sum due to the Electrical Power Storage Company for batteries and material delivered, but which amount is now proceeding to adjustment.

It was understood between the Eastern Electric Light and Power Company and this company, that in the territories jointly held by the two companies, this company should chiefly confine itself to selling batteries and supplying power, and the Eastern Electric Light and Power Company to supplying light; to this end shipments of accumulators were made to India, Malta, and Egypt in execution of orders from the Eastern Electric Light and Power Company during latter end of last year and beginning of this; on their arrival it was found, that owing to the want of experience in packing such novel material, great damage had been done in transit, and much time and patience were required to overcome this misfortune; the absence of necessary apparatus and the imperfect knowledge of the electrical staff of the Eastern Electric Light and Power Company in India in the management of these batteries, showed the necessity of despatching some men practically acquainted with the work; this was done by the Electrical Power Storage Company sending out two of their best men, and fresh material all separately packed, by this means some of the previous difficulties were overcome, and a list of installations in Bombay has been received, showing over 700 electrical horse power which have been erected; this quantity would have doubtless been much increased, but for the prohibitory orders of the Indian Government in enforcing the laying of cables underground; this arbitrary law has most seriously hampered the action of the Eastern Electric Light and Power Company, and in consequence restricted their requirements of accumulators.

The same difficulty of damage in transit, beset the electrician of the Eastern Electric Light and Power Company at Malta, but by dint of perseverance he succeeded in doing good work there, and reports a demand for their use.

In Egypt an installation of incandescent lighting by means of accumulators was made in the Khedivial Palace by the Eastern Electric Light and Power Company, which was highly satisfactory, and were the times more propitious for such work in Egypt, there would doubtless be a large demand.

Having received from Penang very encouraging accounts of the probability of large and profitable work that would be offered there, the directors considered it advisable to take preliminary steps to place the company in a position to undertake such work; to that end their agents at Penang were instructed to obtain, on the best terms possible, the very important concession from the Government of the right to use the great water power on the spot; negociations are progressing for this purpose, and advice has been received that this will be most probably settled, and a draft agreement sent, in course of a mail or two. Two 50-horse power vortex turbines have been shipped, with the necessary shafting and piping for same; the electrician at Penang, Mr. T. S. Gardner, has since made roads to the Water Falls, and placed the turbines in position. The cost of the turbines, shafting, piping, land, roads, reservoirs, and buildings, together with dynamos for charging the secondary batteries, and including electrician's salary, wages, and all other charges for material labour, &c., amount to £3,040 11s. 5d., and the company is now in a position to at any time take up and carry out remunerative work, such as tramways, power, lighting, &c., of which, from the the electrician's report, there is every reason to believe a considerable quantity will be offering.

A call of 5s. per share has been made, such notice is accompanied by a letter in which full detail is given as to the necessity of this call, and of the use to be made of the amount so subscribed.

The shareholders are to be congratulated on the terms arranged with the Electrical Power Storage Company, more especially referring to the 10,000 fully-paid shares being made deferred as regards dividend; this great reduction of the amount of capital upon which profits will be distributed, in the first instance, will, the directors feel assured, be cordially welcomed by the ordinary shareholders.

In concluding the report the directors think it well to place before you their ideas as to the future working of the company. The Electrical Power Storage Company is about to grant this company, without any additional payment, a patent for a new and valuable type of accumulator; the application of electricity as a motive power, has been engaging the attention of many engineers, and the demonstrations made in Paris of the successful working of an electrical tram-car, has shown that, at last, an electro-motor has been constructed capable of varying at will the production of force according to the speed required. With these great improvements at command the company will be in a very much stronger position to undertake work, but the directors have decided in the interests of the company that for the present it is desirable that no undertakings be entered into; that beyond the sale of accumulators all outlay be avoided, and expenses reduced to the lowest point possible, reserving the resources of the company for the time, which the directors fully believe will yet come, when electrical problems will be more fully solved, and electrical appliances more decidedly called for.

[Only a general balance-sheet is appended to this report, no profit and loss account being given.]—EDS. ELEC. REV.

The Chairman: I have to move that the report of the directors and the statement of accounts submitted to this meeting be read and adopted, and in doing so I would very briefly give you an account of what has been done in India. For the first few months after the formation of this company it was found impossible to obtain from the parent company any cells to send out to India. The Eastern Electric Light and Power Company at that time was very anxious to have batteries sent out; we got reports from our executive there that batteries were absolutely essential, and should be sent out as soon as possible, and a certain number was sent out. It would take too long to go through the various mishaps that took place with regard to those batteries, but, briefly, of all the batteries sent out at first, for a considerable period, they were packed in such a way that when they arrived they were worthless, they could not be used. I do not mean to say that none of them were put together by the electricians of the Eastern Company, but that when they were put together, although giving very satisfactory results for a time, they were found ultimately unworkable; the boxes leaked, the plates expanded, and other things rendered them simply unworkable. It was thought that the Eastern Electric Company's engineers were not sufficiently competent to deal with this new invention, and we asked what I may call the parent company to send out from their own works somebody who was fitted to put up the batteries so that they could be worked efficiently. I am sorry to say that the first man sent out found that the batteries he had to deal with were also inefficient. We have not yet had time to go into the question as to the real cause of the inefficiencies of the batteries. The engineer of the Eastern Electric Light Company only returned to England two days ago. I have had some talk with him, but have not had time to unravel the very grave differences of opinion that I find exists between him and others who have engaged in the working of these batteries. In a few days another gentleman will arrive from India who will also be able to give us some information; but the first gentleman who was sent out by the parent company, Mr. Gee, certainly failed to erect useful batteries. He can give you his reasons for that failure; whether they are the accurate ones I have not been able to discover yet. We said we must have these batteries, for in the meantime the Eastern Company was most grievously injured in its work of incandescent lighting, which was earnestly demanded in Bombay, and without these we were unable to furnish that incandescent lighting. The demand in Bombay was very great and very urgent, and large numbers were prepared to take this lighting; so a second man was sent out by the parent company, and he put up some more batteries. I am sorry to say that, for some cause or other, which we shall have to investigate, those batteries, though they worked for a time, did not work satisfactorily, and the persons employing them, those who took the light in Bombay, were so dissatisfied that they said, unless it could be better, they would discontinue it; and I believe at this moment there are no batteries at work in Bombay; the light was undoubtedly inefficient from these batteries. Now, I would further remark that the cause for this, which we have not yet been able to unravel—and statements are very.

contradictory—is not proved, to my mind, to affect the batteries themselves; what the batteries are can be seen in this country. If they can be worked here they can be worked in India; but if they cannot be worked here they cannot be worked in India. We cannot do anything in India that we cannot do at home; but if they can be successful here, they can be successful there. The new accumulator which has been obtained for us obviates a very large number of those special difficulties that we found in Bombay; it obviates the use of boxes, which have been found one of the gravest sources of difficulty out there. Now, all our earlier failures seem more or less connected with the want of efficient boxes; but whether or not that was the case—because the batteries which are still inefficient were in glass boxes—still, that was one of the gravest difficulties that we had, and that is now obviated by this new accumulator. But there are other and still more important improvements in this accumulator. What I want to point out to the shareholders chiefly, and what they feel more interest in, is what we propose to do for the future. As regards the payment of £5,000 to the parent company, on that question the directors have simply no choice whatsoever. That £5,000 is due to the parent company, and whether the bargain was a good or a bad one has nothing to do with the question. It was due to the parent company under a stamped agreement, and was approved by the shareholders; and what is more, that £5,000 goes to pay for what is probably the most valuable asset of this company, that is to say, the security to us of all that is in the Faure patents, and preventing the use of the Faure patents in any conceivable new form, just like this form that is now brought out by M. Philippart. I have got to point out that we propose that this company should carry out no tentative work of its own, but should confine itself at present to seeing what others can do. If it can be shown in this country that tramways or other work can be done by the new accumulators, then I will venture to say that this company has got a better field for its work than any other company in the world. Whatever have been the failures that have been made, Major Strutt will tell you at least this, whatever differences of opinion on other subjects there may be, that for tramway purposes or for incandescent lighting the demand in India is very large; but they are not prepared to take incandescent lighting that fails, and of course nobody is going to take tramway work until it has been shown to be a real success in this country. The new accumulator and new motor apparently have solved this question. A tramway has been run in Paris, run with a set of searching experiments, until they overcame all the difficulties, or apparently overcame them, that beset the introduction of electrical tramcars in this country. If the shareholders are willing—and of course it is for them to judge—to adopt the view of the directors, which is just simply this: we have no choice as to paying the £5,000; when the payments are completed, as they would have been before but that the patents for Ceylon were not completed, we propose to reduce our expenses to a minimum, the directors will take either no fees or nominal ones, and we will just wait till we see the result of the experiments of others in new batteries and new motors; when we can see an electrical tramway running in this country successfully, then I venture to say there is a good opening and a certain profit for this company. At the same time the directors are quite willing, at least I am while I remain chairman—a position I am ready to resign to-day—to undertake that we will enter on no expenditure of any considerable amount, requiring a fresh call, without first calling the shareholders together and informing them of the nature of the enterprise that we propose, and getting their views. The amount, therefore, that they can further lose is very, very small; they have bought some patents; they have got a very valuable field. If these patents are good, are valuable—and that has yet to be fully proved—I don't think it has been yet—but if they are good we have a very valuable field for their use. The course that we are now proposing is one which, after careful consideration, I, being a considerable shareholder myself, am perfectly convinced is the best for every shareholder of this company, and I would never propose it unless I felt perfectly sure that it was to the best interests, not of the directors or patentees, but of the shareholders of this company. I beg to move the resolution.

Mr. Bullivant, in seconding the resolution, said there could be little doubt that the action the directors proposed to take now was the proper one. It was quite impossible for them to prevent the payment of the £5,000; they would have put the company in a very awkward position had they objected to do so, for if they had not paid it they would have been liable to action, and if the company were called upon to wind up they would first be bound to call up the whole of their capital, so as to make themselves equal to the fully-paid shares. What they proposed was just to call up sufficient money to pay off the liability, and leave a small sum in hand to see how the new patents acquired worked—not to call up money for experiments, but to leave the Eastern Company to carry out experiments, which, if successful, they would have the opportunity of taking advantage of.

Mr. Braithwaite remarked upon what he styled a complete change of front on the part of the directors from what was set forth in the prospectus, from which it appeared there was no risk whatever to be run of any loss, as they were merely to buy batteries on the one hand of the Electrical Power and Storage Company, and sell them on the other to the Eastern Electrical Light and Power Company, so that, even if there were no profit, there could not by any possibility be a loss. The Eastern Company were prepared, it was stated, to give them an order for 3,000 horse-power; he should like to know if that had been carried out. What further seemed to render it a safe investment was the fact that there was a working capital of £35,000. The prospectus also stated that a working agreement having been entered into with the Eastern Company, "As a further consideration for this agreement the Eastern Company guarantees the payment of the necessary preliminary expenses of this company," but in the balance-sheet a sum of £3,256 was shown as for preliminary expenses. He would like to know why that agreement was not carried out. It seemed they had paid £25,000 for batteries which had turned out quite unworkable, and now the directors wanted them to buy another battery.

The Chairman: No, no; you are not asked to pay a single sixpence; it is entirely a free gift. The £5,000 is due under an agreement with the parent company, which could go into court to-morrow and get judgment against us, for we have absolutely no defence. Besides, that was approved at the last meeting of the shareholders.

Mr. Braithwaite remarked that he received no notice of the meeting referred to, and several other shareholders also expressed their ignorance of any such meeting.

The Chairman said it was the opinion of the office that every shareholder had received a notice of the meeting, which was the ordinary general meeting of the company, at which the whole thing was explained as clearly as it was possible to do.

Mr. Bedford said several large shareholders, including himself, knew nothing of the meeting referred to, and it seemed to him they ought to know something about that matter. He doubted the legality of the meeting. The best thing that could be done was to adjourn that meeting for enquiries to be made.

The solicitor to the company, pointed out that the parent company had stated positively that they had gone as far as they would go in the way of concessions, and had imposed upon them the necessity of passing the resolutions within a certain period. Therefore if the meeting were adjourned, it would not relieve them of the responsibility of paying the £5,000, and it would probably lead to liquidation.

Mr. Bedford said the question of 5s. was not much in itself, but the point was whether it would not lead to further calls of larger amount. He would rather pay £1 on his shares for liquidating the company than pay that 5s. The whole thing seemed rotten.

Lord Walter Campbell would also be glad to see the company wound up. Most of these parent companies died away, and the children, such as that company, were left utterly destitute.

Major Strutt, a director, agreed with a great deal that had been said, but, as their legal adviser had told them that in winding up they ran a great risk of having to pay £1 where now they only had to pay 5s., he certainly did not think it wise to proceed to that course. His idea was, before settling anything definite, to take other legal opinion than they had had with regard to the payments they would be liable to be called upon to make to the parent company. With regard to the accumulator, it was a gift to a certain extent, but it was an infringement of the Faure patent, of which they were the possessors. When the £25,000 for that patent was paid he was in India, or he certainly would not have consented to it. He did not think the parent company was inclined to grind them down so much as some of them seemed inclined to think, and he did not imagine there was any necessity for making the call for £5,000; they had nearly £1,000, and he thought the parent company would receive £2,500 now and wait six months or a year for the remainder. They owed nothing besides, and were the creditors of the Eastern Company, although he did not suppose the latter were prepared to pay for the batteries they received, as they were not what they expected them to be.

The Chairman said he believed there was a real future before the company, and, as a shareholder, he must really ask shareholders not to throw away for nothing what might turn out to be a good property.

Mr. Bedford said the whole question was as to the payment of the £5,000. Of course they had to pay it; there was no doubt about that. The only thing was whether they could not get the Electrical Storage Company to agree to some easier terms. He was quite willing to be one of a deputation to see the Board and argue the matter with them.

It was eventually decided to adjourn the meeting, as well as the extraordinary general meeting, until Wednesday, January 2nd, 1884, and Lord Walter Campbell, Messrs. Bedford, Braithwaite, Banbury, and Cumberbach were nominated a committee to attend with the directors the meeting of the Board of the Electrical Storage Company, on Thursday, the 27th inst.

The Chairman put it to the meeting whether further legal opinion should be taken as to the indebtedness of the company to the parent company and their position with regard to the shares, but only Major Strutt voted in favour of that course. The meeting then separated.

The International Electric Company, Limited.

THE report of the directors, to be submitted to the second ordinary general meeting of shareholders, to be held at the company's offices, 4, Copthall Buildings, London, E.C., on Monday next, 31st of December, 1883, states:—

The directors have pleasure in informing the shareholders that the company's business is emerging from the preparatory and entering upon the productive stage. Contracts have been entered into for the carrying out of electric light installations to the gross value of fl. 165,612 (£13,801), payable in cash. The company has also entered into lighting contracts, under which the

gross revenue is fl. 91,696 (£7,641) per annum, with an early prospect of increase to fl. 134,512 (£11,209) per annum.

The company has contracted for lighting the whole of the Imperial Opera House in Vienna (this contract was signed and sealed by the Opera Administration on the 2nd of December, and merely awaits Imperial ratification); for lighting the town of Temesvar in Hungary, and for the supply of the conductors and internal fittings for an installation of 1,400 lamps in the palace of the King of Roumania at Bucharest. Careful calculations, based on the results of practical experience, show that the contracts entered into may be fairly relied upon to yield considerable profits.

It is worthy of mention that the Vienna Imperial Opera House contract was only signed after an exhaustive trial, lasting over six weeks, had been made of the company's system of lighting the stage; after full investigation had been made by a Commission appointed for the purpose of all that was to be seen at the Vienna Electrical Exhibition and after the proposals of the company had been referred to and reported upon by the highest technical authority in Austria. The possession of the Vienna Imperial Opera House contract under these circumstances may be regarded as evidence that the company has earned the confidence of official circles.

As regards prospects in connection with installations of this character, it may be mentioned that it is the expressed intention of the Austrian Government to light by electricity the whole range of magnificent Government buildings which line the "Ring" in Vienna, and which are now nearly completed. It is also the intention to adopt electric light in the New and Old Burg Theatres, in the New Municipal Buildings, as well as in the Old and New Imperial Palaces in Vienna. These contracts, some or possibly all of which the directors trust they may obtain, will probably be of the same character as the Opera House contract, that is to say, a contract for the supply of internal conductors and fittings against payment in cash, and a contract for the supply of light at fixed rates for a term of years by means of generating apparatus to be put up by the contractors at their own costs.

As regards the Temesvar lighting contract, the directors believe it will be the forerunner of a very large business in connection with the public street lighting of towns. The street lamps, which are to be 16 candle-power incandescence Lane-Fox lamps, are to be grouped in multiple series, and they will be worked by means of Brush dynamo machines of high electromotive force and small current. It has been arranged with the municipal authorities to keep the public lighting of the streets distinct and separate from private lighting, and permission has been granted to carry the conductors overhead. Under these circumstances the cost of the installation will be comparatively small, whilst the plant will be utilised to its full working capacity during regular and long working hours daily. The difficult problem of economical distribution over a large area is thus solved by the use of a high tension current and light and cheap conductors. The company is in treaty for the concessions for the public street lighting of five other towns.

The contracts entered into by the company are not sufficiently advanced to enable a profit and loss account to be made out, and the directors can, therefore, only submit a balance-sheet made up to 31st October last, showing how the funds at the disposal of the board have been applied.

The development of the company's business has been considerably retarded by the decision generally come to, to await the results of the International Electric Exhibition, which took place last autumn, in Vienna, before entering into any engagements relating to electrical business. Until the exhibition closed in November last, it was impossible to bring the more important negotiations to a point, and this delay has necessarily been a source of considerable expense. It is also on this account that the board deemed it advisable to defer the issue of this report, and the summoning of the general meeting.

The directors have to report with deep regret the loss of one of their most able and active colleagues, Colonel R. W. Hamilton, who died on the 3rd of October last. They also have to report the retirement from the board of Sir Alfred Slade, Bart. Sir Wm. Stephenson and Mr. C. F. de Kierskowski-Steuart retire from the board by rotation, in accordance with the company's articles of association, and, being eligible, offer themselves for re-election. The board recommend the election of Lieut.-Colonel A. C. Hamilton, R.E., of Croxted House, Farnborough, as a director to fill up one of the vacant seats. The directors do not think it necessary to fill up the other vacancy at present.

The West Coast of America Telegraph Company.—The coupons due on the 31st December next on the debentures of this company will be paid by Messrs. Barclay, Bevan & Company. The coupons must be left three clear days for examination,

United Telephone Company, Limited.—The Company notify that their transfer books will be closed from the 27th inst. to the 8th prox. inclusive, for the preparation of the half-yearly dividend warrants.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended 15th December, are £2,199, as compared with £2,778 in the corresponding period of 1882.

NEW PATENTS—1883.

5759. "Secondary electric batteries." A. C. HENDERSON. (Communicated by N. Basset.) Dated December 17.

5775. "Transmitters for printing telegraphs." H. J. ALLISON. (Communicated by S. D. Field.) Dated December 18.

5777. "Circuits for electrical apparatus." H. J. ALLISON. (Communicated by C. E. Allen.) Dated December 18.

5790. "Electrical conductors or conducting wires, conduits for the same and devices for use in connection therewith." H. H. LAKE. (Communicated by C. H. Goebel and G. W. Bratton.) Dated December 18.

5806. "Apparatus for communicating between persons at any distance from one another." G. C. GIBBS. Dated December 19.

5807. "Telegraph transmitters and electric circuit controllers." E. A. BRYDGES. (Communicated by W. F. C. M. McCarty.) Dated December 19.

5813. "Heating steam generators by means of electric currents." F. C. GLASER. (Communicated by H. Hempel.) Dated December 19.

5830. "Manufacture of electric conductors and plates for generating and conducting electricity." J. KAHN. Dated December 21.

5835. "Manufacture of compounds to be used for insulating, protecting, or analogous purposes." A. MUIRHEAD. Dated December 22.

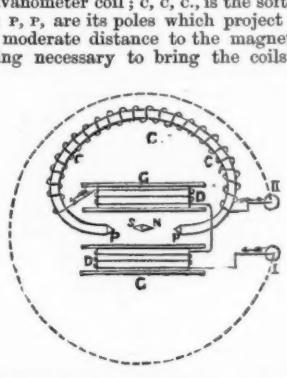
5843. "Secondary or storage batteries." H. WOODWARD. Dated December 22.

5845. "Manufacture and preparation of materials to be employed for insulating purposes." J. L. CLARK. Dated December 22.

5851. "Electro clock regulators." R. H. BRANDON. (Communicated by J. F. Kettell.) Dated December 24.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1877. "Apparatus for measuring electric currents, &c." R. E. B. CROMPTON and G. KAPP. Dated April 13. 6d. Has for its object the production of measuring instruments which after having once been correctly calibrated are entirely free from subsequent variations and give at all times accurate indications. The fig. shows one method of arranging the electro magnet and the deflecting or galvanometer coil; C, C, C., is the soft iron core of the electro magnet; P, P, are its poles which project inwards so as to come within a moderate distance to the magnetic needle, N, S, without its being necessary to bring the coils of the electro



magnet themselves so near to the needle. In this manner the needle is mostly under the influence of the magnetism proper of the iron core of the electro magnet and only slightly or not at all under the influence of its coils, which is an advantage as the directive power tending to bring the needle back to its zero position is thus more nearly made a constant. G, G, is a gun metal frame upon which the deflecting coils, D, D, are wound for convenience; these coils are arranged in two halves leaving sufficient space between each other for the insertion of the needle and its pivots. The current enters at terminal, I, goes round the deflecting coils thence into the coils of the electro magnet as shown by the arrows and finally out of the instrument by terminal, II.

1911. "Manufacture of electrodes for electric arc and incandescence lamps." W. HOUGHTON. Dated April 14. 2d. The invention relates essentially to the substitution for the ordinary form of carbon hitherto employed for the manufacture of these electrodes, of carbon in its allotropic form as it exists in the diamond, and the invention consists in the manufacture of such electrodes, of diamonds, diamondiferous ore or matter the substances or products known as "eolite" (which is a carboniferous mineral found in connection with, or in the same strata as, diamonds) "boart" (which is a sort of crystallised mass composed of numberless small diamonds) and "carbonado" (which is also a diamondiferous ore or deposit) these materials being used separately or together in their natural form or in "cleavage" or in powder or in paste or other manufactured form, alone or combined, amalgamated or mixed with one or more foreign substances to bind together or serve as a vehicle for the diamondiferous product employed. *(Provisional only.)*

1924. "Electrical heating and apparatus connected therewith." J. S. SELLON and R. P. SELLON. Dated April 16. 6d. Relates to the application of electrical energy or currents in whatsoever manner derived, whether from a dynamo or other machine direct or from primary or secondary batteries or from any other source, to heating or other purposes where electrical energy is transformed into heat, and it further relates to appliances or devices for automatically or otherwise regulating the supply of electrical energy or current to be transformed into heat, so that the temperature may be regulated and maintained approximately constant at any degree desired so long as the supply of electrical energy is available; the invention also relates to devices or arrangements for automatically or otherwise regulating and maintaining such currents in electrical heating apparatus so as to prevent an excess of electrical energy or current from traversing the conducting or heating coils or portions of the apparatus, such as might cause waste of power and of heat or might tend to oxidise or otherwise injure or destroy the apparatus.

1932. "Galvanic batteries." C. L. CLARKE. Dated April 17. 2d. Consists principally in the use of silver oxide as the depolarising agent in a galvanic cell; this can be used alone or intimately mixed with carbon powder. For the exciting fluid the inventor uses a solution of potassic or sodic hydrate, when a strong current is required, or he employs, when desirable, a solution of any of the alkaline sulphates or chlorides. For the negative electrode he uses carbon platinum, or, by preference, silver which is coated with oxide and made of suitable form, according to the purpose for which the battery is required; for the positive electrode he uses zinc, also of a suitable shape.

1969. "Receptacles for secondary batteries or electrical accumulators." G. BINSWANGER and T. S. SARNEY. Dated April 18. 2d. Consists in a novel method of constructing receptacles for secondary batteries, in separate parts for the sides, bottom and ends, of substances which shall be fluid-tight, be capable of resisting the action of acids and electrolysis, and otherwise possess the well-known qualities pertaining to materials intended to be employed for the construction of such receptacles. The said materials formed in separate parts, are afterwards secured or joined together at the sides, bottom and ends, in the particular manner hereinafter described. (*Provisionol only.*)

1991. "Dynamo-electric machine and bobbins or Gramme rings therefor." W. P. THOMPSON. (A communication from B. Cabella, of Milan.) Dated April 19, 6d. Has for its object the great reduction of resistance of the armatures in the secondary or induction coils of the Pacinotti or Gramme machines, and others of the same genus—the length of the circuit directly submitted to induction remaining always constant.

1992. "Engines and driving gear for electric machines." R. BROWN. Dated April 19. 2d. Relates to an arrangement of engine and driving gear for regulating the speed of the former. *(Provisional only.)*

1998. "Electric batteries." B. W. WEBB, H. P. F. JENSEN, and J. JENSEN. Dated April 19. 4d. Relates to electric batteries, and is chiefly designed to provide an improved "dry battery," which will operate efficiently, without renewal of the exciting paste, for a greater length of time than dry batteries as heretofore made. The said invention comprises an improved composition or exciting paste made of the following ingredients, namely:—Plaster of Paris, gypsum, or similar substance containing sulphate of lime; chloride of sodium; sal-ammoniac; and yeast; in, or about in, the following proportions, that is to say:—

Plaster of Paris (Ca O. SO_3) or the like, 21 parts by weight.
Chloride of sodium (Na. Cl.) 9 parts by weight.
Sal-ammoniac (NH Cl) 9 parts by weight.
Yeast 5 parts by weight.

These substances are mixed with 16 parts by weight of a solution of sal-ammoniac, and, if desired, 16 parts by weight of sulphate of zinc may be added. This mixture is stirred until a smooth paste is formed, more or less plaster of Paris being employed according to the stiffness required. The inventors sometimes add to the above-named ingredients a small quantity of permanganate of potash, if the paste is required to be very hard. In order to permit sufficient air to have access to the composition they insert in the paste before it hardens one or more pieces of elder pith. The dry salt and sal-ammoniac do not dissolve at once in the solution but are retained in the paste as a reserve. The salt slowly dissolving acts upon the sal-ammoniac by degrees and thus maintains the battery in working condition for a very long time; the yeast serves to keep the paste in a porous condition, and the sulphate of zinc helps to preserve the zinc element and keep it clean. Either copper, carbon or other suituble material can be used for one element and zinc for the other element, but it is preferred to use manganese blocks, or blocks made of a composition of carbon, manganese, and iron for one element, and zinc for the other element.

2020. "Telephone or telegraph call apparatus and circuit arrangements." H. A. C. SAUNDERS and A. C. BROWN. Dated April 20. 6d. Relates to the apparatus described on page 505.

2023. "Supplying, maintaining and regulating electrical force for battery charging, &c." R. P. SELLON. Dated April 20. 6d. Relates to apparatus for supplying and maintaining a constant store or supply of electrical energy in secondary batteries or accumulators or other apparatus, or for other purposes; and to devices for automatically causing a charging current supplied by a dynamo or other means to energise such secondary batteries or other apparatus until such time as they are charged to the full or desired extent, and then automatically breaking or diminishing the said charging current or throwing the generator or dynamo machine out of the charging current or causing it to cease from generating electricity, the charging current remaining broken or the generator remaining at rest or supplying no current to the batteries or other apparatus or to any particular set of batteries or other apparatus among a number of them either in series with one another or in multiple arc, until such time as the electromotive force or current of the secondary batteries or other apparatus drops or diminishes owing to a withdrawal of a portion or all of the current supplied by such apparatus for any purpose such as lighting, heating, or the transmission of power, when the charging current may be automatically re-established, either by means of an automatic switch or by means of an electro-magnet or magnets or other devices controlling mechanical devices for throwing the generator or other portion of the apparatus in and out of gear with the motive power supplied by any source, such as steam or gas engines, or motors impelled by wind or water power, such as, for instance, windmills or turbines. The invention further relates to devices and apparatus for maintaining a constant or approximately constant electro-motive force or current at the pyles of a dynamo where the speed of the motor or dynamo varies to any extent, such as might be very apt to occur where wind power is utilised for battery charging or other purposes,

2025. "Apparatus to be used in telephonic systems for putting any of the instruments connected with a central station into communication with each other." W. R. LAKE. (Communicated from abroad by H. T. Cedergren and L. M. Ericsson, both of Stockholm.) Dated April 21. 4d. The object of the said invention is to enable any of a number of telephonic instruments in a circuit, or any instrument of the telephonic system not situated within the same circuit to be put, by means of a single conducting wire, in direct communication with the central station. (*Provisional only.*)

2031. "Primary voltaic batteries." P. JENSEN. (Communicated from abroad by Dr. A. Prinz, W. Wenzel and J. Kahn, all of Vienna.) Dated April 21. 2d. A piece of metallic zinc is covered with an envelope of parchment paper, collodion or other known membrane suitable for osmose; this electrode is placed in an outer bag made of like pervious material and containing diluted sulphuric acid. This again is placed in a receptacle made of copper and perforated all round; this copper vessel is coated inside and outside with membrane suitable for osmose, and stands in a container or vessel which is charged with saturated solution of copper vitroil to which is also added free sulphuric acid. This copper vitroil solution must always be kept saturated, which is effected by placing therein pieces of copper vitroil. *(Provisional only.)*

2042. "Magneto-electric machines, dynamo-electric machines and electro-motors." G. HOOKHAM. Dated April 21. 8d. Has reference principally to magneto-electric machines in which the permanent inducing magnets rotate while the armatures in the coils on which electric currents are inducted are stationary. In constructing a magneto-electric machine according to the invention the inventor employs permanent steel magnets having the figure of the letter V.

2044. "Dynamo-electric machines." A. M. CLARK. (Communicated from abroad by La Société Solignac et Cie, of Paris.) Dated April 21. 6d. Relates to a continuous current machine in which the induction of the wire is utilised as in the Gramme machine, and the induction by the iron as in the Siemens machine, having an armature core of H section.

2057. "Electric lamps and circuit connections, &c." W. HOCHHAUSEN. Dated April 23. 1s. In the improved electric lamp the inventor makes use of two helices, one in the main circuit through the carbons and the other in a shunt, and there are solenoid cores to these, and the core of the helix in the main circuit is weighted, so that it falls if the current through the carbons is interrupted by accident, such as the breaking of the carbon, in which instance the mechanism holding up the carbon is liberated, and the upper carbon descends to the lower carbon. When in a normal working condition the weighted solenoid is held up in a fixed position, and the regulation of the arc is effected by the variations of current passing through the shunt helix.

2058. "Magneto and dynamo-electric machines, &c." W. HOCHHAUSEN. Dated April 23. 1s. In this invention means are provided for moving the brushes and supports bodily around the commutator plates so as to take off more or less current as required according to the number of lamps in circuit and the demand for electric current. A motor driven by electricity or mechanism is used for moving the brushes; the electric motor is in a balanced shunt circuit and the balance is disturbed by the change of magnetism in the field-magnets acting upon contact blocks in the balance circuit, so that the motor is operated when the magnetism is disturbed.

2062. "Thermo-electric generators." H. WOODWARD. Dated April 24. 6d. Relates to improvements in thermo-electric generators, whereby they are rendered more efficient, compact, and durable than those hitherto constructed. In carrying out the invention the inventor prepares an alloy of antimony and zinc, and casts or forms it into a number of elements of any suitable shape, but the form preferred resembles that of a grooved pulley in cross section, and to these elements is attached, by casting or otherwise, suitably shaped tinned iron pieces or strips. These elements, and the tinned iron pieces or strips thus combined, are arranged

over and around a chamber or casing, and they are connected in the usual manner. The inner ends or faces of the pairs are kept heated, and the outer ends or faces are kept cool.

2064. "Apparatus for preventing excessive heat in dynamo-electric machines." H. ROBERTS. Dated April 24. 6d. In this invention air is blown upon the revolving armature with one nozzle from above, and with two nozzles from opposite sides, all directed radially inward towards the axis. The blast for the whole is produced by a single blower, and is led through a trunk pipe and three branches therefrom, one branch leading to each nozzle.

2082. "Galvanic batteries." W. E. T. DAWSON. Dated April 24. 2d. Has for its object the preparation of zinc electrodes for galvanic batteries in such a manner as to greatly increase the durability of the plates, and to render the battery more constant. For this purpose, according to one method, the inventor provides the zinc plate with an electro deposited coating of mercury, such electro deposit being effected in any known manner, such as by immersing the zinc plate in a solution of mercury, or salts of mercury, and passing a galvanic current through it. According to another method, the inventor effects the coating of the zinc plate with mercury by the use of mercury vapour, which may be conveniently effected by enclosing the plates in a chamber into which mercury vapour, produced by heating mercury, is introduced, and thus becomes deposited in metallic form on the plates. *(Provisional only.)*

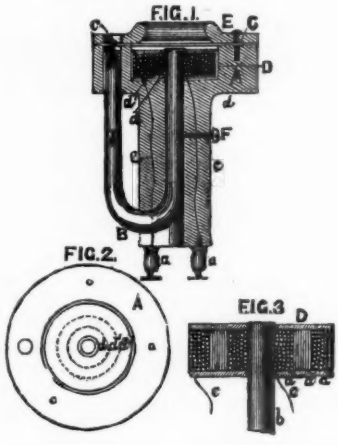
2108. "Electric motor apparatus." M. KOTYRA. Dated April 26. 2d. Relates chiefly to an improved electric motor wherein the inventor utilizes the direct attraction of a magnet or magnets upon a series of armatures. These magnets and armatures are so arranged, in combination with a rod or bar, that the armatures, which are successively attracted by the magnet or magnets, act in succession upon the said bar or rod, and impart motion thereto; or the said armatures might be fixed, and the magnets be so arranged as to act in succession upon the said rod or bar to move the same. By employing two rows of fixed magnets, with the armatures arranged between them, and providing means whereby the rows of magnets can be alternately excited, The inventor is enabled to impart reciprocating motion to the said bar or rod in a line transverse to its axis. *(Provisional only.)*

2117. "Switch apparatus for connecting and disconnecting electrical lines for telegraphic or telephonic communication." J. IMRAY. (Communicated from abroad by T. A. Connolly, of America. Dated April 26. 2d. Relates to switch apparatus for effecting connection and disconnection of electric lines or conductors employed for telegraphic or telephonic communication, so that, in cases where a number of such lines radiate from a central station or exchange, any one of these radiating lines can readily be put in connection with any other. In this apparatus the motive power for effecting the connection is obtained by mechanical means brought into operation and controlled by electrical appliances, so as to avoid using the electric current to do mechanical work. *(Provisional only.)*

2118. "Electrical accumulators or secondary batteries." PAGET HIGGS. (Communicated to him from abroad by C. Forbes, of America.) Dated April 26. 4d. In carrying the said invention into practice, the inventor provides plates, cakes, or pieces of any desired shape, which he makes of the undermentioned materials, and in the following manner, that is to say, he takes some finely divided lead, also some very finely pulverised graphitoidal carbon and mixes the same together in such a manner that each particle of lead will be surrounded by particles of carbon, preferably there shall be more carbon than lead. The compound so made is exposed to the atmosphere for a sufficient length of time to cause the lead to become oxidised, whereupon the said compound is mixed with a solution of sugar in water and then made up into pieces of any desired shape or dimensions. The sugar has a slightly solvent action on the lead and mechanically causes it to adhere to the carbons so that the blocks or pieces are very compact. The plate or other piece so prepared is placed in a suitable holder, and if in the form of a plate (which is preferable it is put between two very thin sheets of perforated lead. This plate either whilst thus protected, or previously thereto, is for a short time made the anode in a solution of caustic alkali in order to form a clean surface on the particles of lead for the next operation; the said plate is then made the cathode in a bath of a mercury salt in order that mercury may be deposited upon the surface and the lead particles thus become amalgamated. The plate thus prepared is ready to become the positive pole or electro-negative plate of a storage battery or accumulator. For the positive plate or negative electrode of the battery it is preferred to employ an alloy of zinc or a plate of iron.

2152. "Incandescence electric lamps." L. G. B. ARRIGHI. Dated April 28. 2d. The bulb and the neck of the globe are formed in one piece and are never separated, as is customary in the formation of some lamps, but the orifice of the neck is contracted to a diameter about equal to the diameter of the tube through which the metallic conductors connected to the incandescing filament are led into the bulb. These conductors are fused into the inner or superior end of this tube (or into legs or extensions thereof), which is at its other end turned outward so as to overlap the end of the neck of the globe to which it is fused. *(Provisional only.)*

2322. "Transmitting and receiving telephones." C. W. HAYES and S. R. BECKWITH. (Communicated by M. Leslie Baxter, of Aurora, in the county of Kane and state of Illinois, in the United States of America). Dated May 8. 6d. The first part of the invention relates to the transmitting telephones described in the number of the REVIEW for May 26th. The invention also relates to improvements in telephone receivers especially adapted for use in conjunction with the improved transmitter. Fig. 1 is a vertical section of a receiving telephone made in accordance with the invention. Fig. 2 is a plan view of the same with ear piece, E, left off. Fig. 3 is an enlarged vertical section of the coil and a part of the magnet and shows a modification of the coil. A is the



stock or holder, made of wood, hard rubber or any other suitable material, with ear piece, E, attached in any convenient manner for clamping and securely holding by its periphery the vibrating iron diaphragm, C. B is a U-shaped permanent magnet to one leg, b^1, of which the aforesaid diaphragm, C, is attached by a screw, *c*. By this arrangement a strong magnetic effect is produced between the pole, *b*, and the diaphragm, C. D is the actuating or inducing coil, consisting of concentric parts, *d*, d^1, d^2; *e*, *e* are the connecting wires connecting the parts *d* and d^2 with the binding posts, *a*, *a*. F is a set screw for securely clamping the magnet in place in the stock, A, at a proper distance from the vibrating diaphragm 6.

CORRESPONDENCE.

The Thomson-Houston Electric Co.

I notice in your issue of November 10th, 1883, under "Notes," page 363, a statement concerning "The Thomson-Houston Electric Light Co., of America." The statement should be "of Canada," in order to avoid confusing it with "The Thomson-Houston Electric Co." which is the parent company, owning the American patents. The output of this latter company during the last year has been very large, and is now over 100 arc lights per week, or four to five 25-light dynamos weekly. The very largely-extended facilities of the company at its new factory at Lynn, Mass., will enable it to turn out apparatus still more rapidly from the present time, and the company hopes soon to be able to fill promptly all its orders, which are now accumulated ahead of the supply. The parent company has been putting out apparatus since early in 1881, but the bulk of its installations have been made since 1882.

J. J. Skinner,
Secretary.

Boston, *Dec. 7th*, 1883.

Atlantic Cables.

In reply to your correspondent, "Nemo" (December 8th, page 456), I was not aware that the "Exclusive rights for 20 years of landing at the Azores," quoted from the Paris *Figaro*, included the obligations he mentions. The comparison stated in my letters, referred to a route between England and Nova Scotia direct, and between the same points *viâ* the Azores.

A. O.

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